ENGINEERING NEWS

HERR ALFRED KRUPP, proprietor and practically creator of the great iron works at Essen, died on the 14 inst, at the age of 74. On the whole he may fairly be said to be the greatest "Captain of Industry" which the world has ever seen, and the phenominal magnitude and success of his works were due to a mechanical and executive genius as rare almost as the poetic genius of Shakespeare. The works were founded by his father in 1810, just before the birth of his greater son, and now cover 600 acres and employ 20,000 men. The estate is estimated at more than $50,000,000, a large part of it in the value of the works, which it is to be feared will not be hereafter what they have been.

SHORT electric railways are multiplying very fast. In our issue of May 28, we published a list of such railways in the United States. Quite recently the following have been announced:—

Newport, Ky., horse road changed to electricity.
Findlay, O., 4 -mile road building.
Lakeside, O., 3 - " " "
Mansfield, O., 4½- " " "
Port Huron, Mich., changing from horses to electricity.
San Francisco, Cal., 3-mile road, " " "
St. Paul, Minn., 2-mile line opened July 4.
St. Joseph, Mo., road running 30 cars, to be ready this fall.
Worcester, Mass., Lake Quinsigamond Road, 4 miles, changed from steam to electricity.
Alleghany, Pa., 4-mile road to be ready Oct. 1.
Ashbury Park, N. J., 3-mile road, 15 cars.
Birmingham, Ala., 2-mile road.
Jamaica, L. I., 10 cars.
Lima, O., 3-mile road.
St. Catharines, Ont., 2-mile road.
Fulton St., New York, 1-mile road.

In all, it is stated in a carefully prepared article which appears in the New York *Evening Post*, where we find the above list, that nearly 40 electric railways will be running in this country before winter. We think there are strong reasons to believe that the plant used on every one of these lines will be very materially improved, both as respects weight, cost and efficiency in the near future, yet the six firms who now take the most prominent part in supplying these plants are plausibly stated to be overcrowded with orders. It is apparent that the age of electricity has come to stay, and that wide as is its use now, it is but a fraction of what it will be within a few years.

It is also now seriously proposed to heat as well as light street cars by electricity, running the wires through a plate of fire clay, about 12 ft. × 8 in. × 1 in. thick. It is stated in the newspaper accounts, probably with scant truth, that "the amount of current required for this purpose is almost insignificant, and would cost nothing as compared to the expense of stoves." We may get some idea of the truth in this way: With first-rate steam engines and dynamos about 8 per cent. of the theoretical energy of the coal might, perhaps, be put upon the wires in the form of electricity. We presume no more than a moderate per cent. of loss, say 25 per cent., or very possibly less, is involved in turning this electricity back into heat. About 6 per cent. of the total heat given off by the coal might, on this basis, be given off by the electric wires. It could hardly be more than this, and might well be much less. This seems small, but it is more than doubtful if more than this proportion of heat is given off in an effectual way from an ordinary fire heating a car, for most of it goes out the stove pipe and much of what is left is worse than wasted by bad distribution within the car. There is certainly a physical possibility in the direction of electric heating, therefore, which should lead us to look on experiments in that direction with interest.

THE transit from Japan to England, *via* the Canadian Pacific R. R., has just been accomplished as follows:—The *Abyssinia* left Yokohama on May 13; reached Vancouver on June 13; her passengers arrived at Montreal on June 20, were detained 1½ days in New York, and reached Liverpool on June 30. This is less than 32 days from Yokohama. But the same thing can be done by several of the American trans-continental routes. By way of the Suez canal the same trip, takes 44 days, and *via* Gibraltar, 53 days for passengers and freight.

ACCORDING to the *Handles Zietung*, of Berlin, the Empress of China, under the advice of Prince Ching, viceroy Li and the Marquis Tseng, has sanctioned the laying of a railway from Kaiping to Takoa and Tientsin, and also contracts for 125,000 tons of rails and 60,000 tons of bridge material. The railway is to be managed by the Kaiping Railway Company. While there seems to be an "intolerable deal of sack" to the "half-pennyworth of bread" in the proportion of bridge-iron and rails, we give the report for what it is worth.

THE elevated-track project of the Penna. R. R. Co., in Jersey City, is delayed by the action of the city with regard to Green street. This street runs parallel to the river front and is the second street from the river. Unless it is vacated the Penna. Co. will be unable to connect its proposed elevated system to the Bergen Hill with the vast yard now existing and necessary for the transaction of business. The vacated length on Green street would be short and is altogether devoted to manufacturing, but other means of access would remain. The Penna. R. R. Co. is now said to be contemplating the removal of its terminus to 1st. street some 1500 ft. or three blocks further up stream, moving its ferry with it of course. Some of the citizens regard this action in the light of a "bluff," but unless the Jerseymen yield to a demand that is vital to the success of the elevated railway tracks the company may make the move. They already have elevated tracks connecting with the grain elevator and abattoirs on the river front and own a large area of land at that point. There is even now a rumor afloat that orders have gone forth to replace the wooden trestlework supporting the abattoir tracks by substantial iron work.

THE worst railroad accident of the week would have been, but for "a guard rail on a somewhat dilapidated bridge," on the Lexington & Arlington branch of the Boston & Lowell R. R. near Bedford, Mass., on July 11. A train from Boston, running at a high rate of speed, was approaching the Shawsheen river bridge, when the rear truck of the tender broke loose. The train ran across the bridge with the tender trucks, "which dragged along on the left side, striking the guard rail of the bridge, bending it in a curious shape. This alone prevented the train from plunging into the river, resulting in a terrible accident." About 50 ft. above the bridge the smoker was derailed and went over an embankment. No one was seriously hurt.—The most serious accident, in actual loss of life, was a head collision, July 13, between a special engine and a south-bound express near Robinson, Ky., on the Kentucky Central Railroad. The engineer of the special was killed at his post.

THE Abt rack-rail system, it is stated, is to be tried on the steep portions of the Bolan Pass Railway on the way to Candahar. It is reported that two engines and material for 10 miles of track have been forwarded.

WE are not surprised that the system is being more extensively applied, as it is certainly the best and most perfect form of rack railway which has been as yet devised. In very many cases, however, a switch-back would be both cheaper to construct and cheaper to operate, while giving equal facility for getting over any ground desired. This is particularly the case with the locality covered by the first Abt line, but if one is to use a rack railway at all, it is difficult to see wherein the Abt system can be hopefully modified.

THE strike of the locomotive engineers on the Brooklyn elevated railway may very easily have been provoked by injudicious or overbearing conduct on the part of the officers which has not been made public, but in the main it appears merely to have been another instance of the tendency of "organized labor" to resort to strikes on the slightest provocation in preference to national negotiation, especially when a temporary annoyance is caused thereby to thousands of people which is relied on to work in its favorr, egardless of the merits of the case. The Locomotive Brotherhood has been quite free from such conduct of late years, and it is doubtless fortunate for them as well as for the public that this unnecessary resort to coercive measures is doomed to the complete defeat which seems probable.

AT the last session of the Illinois legislature an act was passed giving the Board of Railway and Warehouse Commissioners power to accept or reject any block signalling system at grade crosings of intersecting roads. In Indiana and most of the Middle and Eastern States a similar law is already in effect. This act supercedes the old law requiring a full stop at such crossings in Illinois.

ACCORDING to late Berlin despatches military engineers are hereafter to conduct the construction of all State railways. And as a beginning military engineers are to at once commence the building of a new line between Wismar and Carow in Mecklenburg.

SOME English shipmasters do not regard the night navigation of the Suez Canal by means of the electric light as an altogether safe and advisable proceeding. They say that by the time they face the full glare of an Egyptian desert all day, and a dazzling electric light all night the navigator and his sailors are in little condition to thread the shoals and dangerous passages of the Red Sea and Gulf of Suez. The dredgers in the canal also work mainly at night and while it is hard enough work to pass them in the day-time it is still worse at night.

DURING the week a rain storm caused two washouts on the Greenwich & Johnsonville Railroad, New York; and a similar storm caused the destruction of three bridges over a small stream near South Washington, Vt. Extensive washouts are reported on the Sonora Railroad. The breaking of a big dam on Blossom Lake caused a disastrous flood at Thompson Falls, Idaho; bridges were swept away, two mining towns nearly destroyed and considerable damage done to the railroad and highways; many lives were lost.

As typical of the times we might mention that the Cook & Son Tourist Agency, that is to "personally conduct" the American Society of Mining Engineers on their Utah-Montana convention tour, has also arranged to conduct the Mahommedan pilgrims of India to Arabia. Shades of Mahomet! Think of the issuing of 1st., 2nd, and 3rd. class tickets to the sacred soil of Mecca.

Herapath's Journal gives approximately the results of the English "railway half year" as showing on the 23 lines a net gain in receipts of £2,168,270.

THE Chicago Committee on Fire and Water have just approved of the plans submitted by City Engineer ARTINGSTALL for an 8 ft. tunnel extending about 4 miles into the Lake, on a line as nearly east as possible from 12th. st. The location of the new pumping stations was postponed for several weeks.

ENGLISH papers again report that the Emperor of Russia has decided that the Government shall at once commence construction on the "Through Siberian Railway" to Vladivostock, referred to by us on July 2. *Engineering* now states that the proposed railway will only be "through" in the sense of connecting existing water ways by short stretches of railway. This will do very well for summer travel, but in winter things will be much as they were.

In the meanwhile the press of this country and Europe are expressing "great expectations," in the way of rapid transit, from the completion of this "through route" across Asia. It is said that St. Petersburg will only be fifteen days journey distant from the Yellow Sea. And figuring upon this basis the "80 days around the world," of JULES VERNE, will be reduced to 50 days. But even if these anticipations are not at once realized by an all-rail line, there is little doubt that it is only a question of time when the gaps along the waterways will be filled up by railroads and the "through route" realized.

"Dredging Operations and Appliances."*

BY JOHN JAMES WEBSTER, M. INST. C. E.

In all projected schemes for either the construction of harbors, docks and canals, or for river improvements, one of the most important questions to be taken into consideration is that of the dredging operations, and the form of appliances best suited for the existing conditions and requirements. The author therefore proposes, first to mention briefly the nature of the different conditions and circumstances which render dredging operations necessary; and secondly, to describe the different appliance which have been used in connection with these operations.[1]

Dredging operations are generally carried out for the following objects, viz. (1) To prepare the surface of the ground under water for receiving the foundations of some structures, such as a breakwater, pier, quay-wall or bridge piers; (2) for deepening or widening some existing canal or river; (3) for cutting a new river course, canal or channel, or diversions of existing ones; (4) for removing obstructions to navigation, such as a bank or bar at the mouth of a river, harbor or dock; (5) for removing the deposits which accumulate from different causes after any of the above works have been executed.

Wherever large amounts of material must be removed for forming or deepening a channel, it is expedient, if possible, by suitable works, to obtain the aid of natural scour for supplementing or dispensing with dredging. Thus, whereas the Suez canal had to be constructed by excavation and great dredging operations, the improvements at the mouth of the Mississippi have been accomplished by training works, and the resulting natural scour of the river. Dredging, in fact, should not be adopted where nature can be induced to do the work.

In nearly all works where excavations are dependent upon dredging alone, silting gradually takes place, and the dredging operations have to be continued for maintaining the channel; whilst, if a natural scour can be induced by the dredging, the works are more likely to be permanent. For instance, if it was attempted to form a channel through the bar of the Mersey by dredging alone, the result would be continued silting, and most probably, in this case, as rapidly as the excavations were made.

The bar which existed at the entrance to Carlingford Lough forms an exception to the above rule; for although it was removed by dredging alone, it is most probable that the removal is permanent. That bar, however, was not formed, like many bars, by the matter in suspension being deposited in the slack water caused by the meeting of two currents of water, but was evidently a continuation of the land formation into the sea, as it consisted of very stiff clay mixed with large boulders.[2] The bar at the entrance to Dublin harbor was removed entirely by induced scour, caused by the construction of the south and north walls.[3]

Two of the most noted examples of extensive dredging operations and training combined, are those which have been carried out on the Clyde and on the Tyne; but much more interest attaches to the results on the Tyne, on account of the more permanent character of the improvement, and of the very short time occupied in carrying them out, compared with those on the Clyde.

In Glasgow harbor,[4] the depth at high-water has been increased from 5 ft. 8 in. to 26 ft. and at low-water from 18 in. to 15 ft.; and although the various works of improvement on the Clyde have been in progress for nearly 130 years, the present condition of the river is almost entirely due to the later dredging operations, about 60,000,000 cu. yds. having been removed within the last 40 years. This improvement, however, cannot be called permament, for a fleet of heavy dredgers is still necessary to maintain the channels; and about a million and a half cu. yds. of material are dredged annually.

The works on the Tyne have produced more permanent results; and they have been mostly carried out since 1861, for the improvement of the river for a distance of 19¼ miles from the bar. Before that time, the depth over the bar at low-water was not more than 6 ft.; it is now from 20 to 24 ft. The nature also of the river, from the mouth to Wylam, has been almost entirely changed; vessels of 27 ft. draught can now enter the river; the interval between the times of high-water at different points has been greatly decreased; the flood-line has been lowered considerably; and the scour has been greatly increased by the flow of a greater amount of tidal water into the river. These improvements have nearly all been effected, within the space of 25 years, by the aid of training-walls, piers, or breakwaters, the removal of obstructive rocks in the estuary, and by dredging, the latter operations no doubt contributing the most to the success. Since the year 1862, 46,000,000 cu. yds. have been excavated by dredging. The deep water is being extended higher up the river; and to accomplish this, and maintain existing channels, extensive dredging operations are still being carried on.

The dredging for removing silt from docks involves often a large annual outlay; and it might be greatly reduced by preventing the influx of muddy tidal water, and replenishing the water in the dock, from some clear source, by pumping or other means. This plan has been successfully adopted by Mr. ABERNETHY, Past-President Inst. C. E., in the new Alexandra Dock at Hull; but unless the conditions of the site are particularly favorable for such a scheme, the first cost would swamp a small undertaking.

Another very important point is the disposal of the dredgings, which, under the most favorable conditions, is often a much more expensive operation than the dredging itself. Where the dredging is carried on outside a harbor, or very near to the open sea, there cannot be any dispute as to where the dredgings should be discharged; but where the operations are carried on many miles up some estuary, or broad river, opinions seem to differ. The natural temptation is to discharge the mud barges, or lighters, into the deepest part of the estuary or river, on account of the great extra cost of taking them out to sea; but, as a rule, the conservators of the river object to this, and insist upon their being taken away to sea, for fear of banks being gradually formed and navigation impeded.

The disposal of the dredgings must depend upon the velocity and volume of the tidal water, the amount and character of the matter in suspension, the existence of a bar or otherwise, the nature and quantity of the dredgings, and the form of the estuary. In some cases, however, the dredgings are utilized for filling in, and making banks, as, for instance, in the construction of the Suez canal.

DREDGING APPLIANCES.

The earliest recorded dredging operations appear to be those carried on by Italians and by the Dutch: and to the latter people we no doubt owe the introduction of the first dredging apparatus, commonly known as the "bag-and-spoon dredger." Although this dredger is very primitive in its design, yet it has been in constant use till within a very few years; and even now a very similar arrangement is occasionally used for removing the accumulated deposits behind dock-gates.

The first dredging machine which was worked by steam-power, [5] as far as the author has been able to ascertain, was that made in 1796 for cleansing Sunderland Harbor, the engine being made by Messrs. BOULTON & WATT, of Soho, Birmingham.[6]

Since that time, numerous dredgers have been designed to meet different requirements; but it cannot be said that the remarkable improvement which has characterized the development of many other classes of machinery, has been realized in the modern dredger; for there is much to be accomplished yet, before a really efficient machine for heavy work is designed.

The different appliances may be classed as follows, viz.—(1) Miscellaneous dredging apparatus; (2) Sand-pump Dredgers; (3) Dip or Bucket Dredgers; (4) Bucket Ladder Dredgers; (5) Hopper Dredgers; (6) Hoppe Barges.

MISCELLANEOUS DREDGING APPARATUS.

Under this head, several machines or appliances will be described, which perhaps can hardly be calle

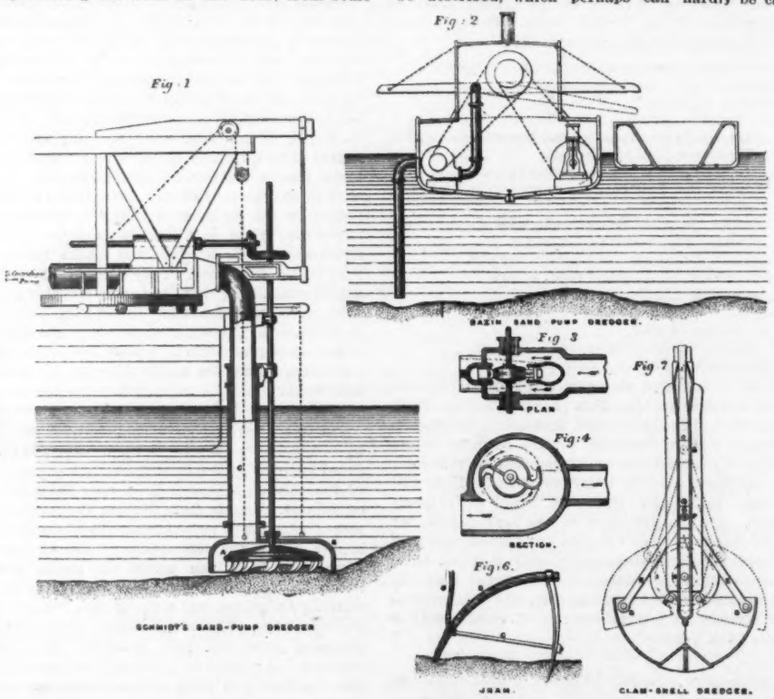

Plate I.—Dredging Appliances.

dredgers, although they are used for cleansing and deepening rivers and harbors.

Kingsfoot's Dredger.[7]—Mr. HAYS has described a very ingenious arrangement which was used for cleansing the River Stour. It consisted of a boat, with a broad rake fitted to the bow and capable of a ljustment to different depths: at the sides of the boat were hinged two wings, of the same depth as the rake, and in a line with it. When the rake was dropped to the bottom of the river, and the wings extended to the side, they formed a sort of temporary dam, and the water began to rise gradually. As soon as a sufficient head was raised, varying from 6 to 12-ins., the whole machine was driven forward by the pressure, and the rake carried the mud along with it. A progress of about 3 miles an hour was made in this manner; and to prevent the accumulation of the dredgings, operations were commenced at the mouth of the river, and carried on backwards. The apparatus was very effective, and the river was cleansed thoroughly; but the distance travelled by the dredger must have been very great.

Rietschoten's Propeller Dredger.[8]—In 1876, J. J. VAN

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* From Proceedings of the Institution of Civil Engineers.

1 Besides giving the results of his own experience and descriptions from published accounts, he is indebted to the following engineers for supplying him with information, or giving him every facility for obtaining it; viz., Mr. G. FOSBERY LYSTER, M. Inst. C. E., Engineer-in-Chief to the Mersey Docks and Harbor Board; Mr R. A. MARILLIER, M. Inst. C. E., Engineer-in-Chief to the Hull Dock Company; Mr. H. H. WAKE, M. Inst. C. E., Engineer to the River Wear Commissioners; Mr. P. J. MESSENT, M. Inst. C. E., Engineer to the River Tyne Commissioners; and Mr. W. SMITH, M. Inst. C. E., Engineer to the Aberdeen Harbor Commissioners. Several of the patentees and manufacturers of special appliances, also, have kindly supplied him with drawings and information, and lent him their models.

2 Minutes of Proceedings Inst. C. E., vol. xliv. p. 132.

3 Ibid., vol. lviii., p. 104.

4 Evidence of Mr. JAS. DEAS before the Select Committee of the House of Commons on the Manchester Ship Canal Bill, 1885.

5 Encyclopædia Britandica, ninth edition, vol. vii. p. 464, "Dredging."

6 The present firm, Messrs. James Watt & Company, have kindly supplied the author with the following information about this dredger:

"Our firm supplied, in 1796, a beam-engine, having a steam cylinder, 12 1-8 ins. in diameter, and 3 ft. stroke, for working the spoons, which were previously worked by men, for cleansing Sunderland harbor. These spoons were in the form of a truncated cone, the narrow end of which was closed: and to the other, or open end, was fixed a spade bit. They were made of a hide of leather, having an iron rim. The engine was to be fixed in a boat, 20 or 22 ft. wide by 60 ft. long.

7 Transactions Inst. C. E. vol. II. p. 241, and Plate 15.

8 Minutes of Proceedings Inst. C. E. vol. lviii. p. 145.

RIETSCHOTEN designed an apparatus for removing the shoals in the River Maas, and called it the "Propeller Dredger." It consisted of an old gun-boat fitted with a pair of trussed beams, one on each side, which carried a steel shaft, and were capable of being lowered or raised by means of a crab on board. An ordinary propeller, 3 ft. 6-ins. in diameter, was fixed to the lower end of each shaft; and by means of bevel-gear at the top, they were driven from a cross shaft by belting from the fly-wheel of a portable 12 H. P. engine. The propellors were lowered until they nearly touched the shoals, and then set in motion at a speed of about 150 revolutions per minute. This operation scoured away the shoal most effectively; for in about forty minutes, it had been lowered 3 ft. over a space 150 yds. long by 8 yds. wide.

Lavalley's Injection and Suction Dredger.[9]—Owing to the great difficulty of working an ordinary bucket-ladder dredger when there is even a small swell, Mr. LAVALLEY, in 1877, designed an arrangement for the harbor of Dunkirk, to overcome this difficulty. A pump injects water into the sand, down a pipe terminating in three nozzles, to stir up the sand; and another centrifugal pump draws up the mixed sand and water, and discharges it into a hopper, the pumps and all machinery being on board the hopper. To allow for the rising and falling of the vessel, either by the action of the tide, or by a swell, the ends of the pipe are made flexible. The hopper has a capacity of 190 cu. yds., and is propelled, and the pumps are worked, by an engine of 150 H. P. From 50 to 80 cu. yds. per hour can be raised by this dredger.

The Aquamotrice.[10]—This apparatus, designed by Mr. POPIE, was used on the Garonne at Agen, and appears to be a modification of the old bag and spoon arrangement. A flat-bottomed boat, 51½ ft. long by 6½ ft. wide, was fitted at the bow with paddles, which were actuated by the tide. Connected with the paddles was a long chain, passing over a pully on uprights, and under a roller; and a beam was attached to the chain, 14 ft. 8 in. long, passing through a hole in the deck. At the end of the beam was an iron scoop, 2 ft. wide and 2 ft. 6 in. deep. When the tide was strong enough, it drew the scoop along by means of the paddles and chain; and the scoop, when full, was discharged by means of a lever opening it. About one discharge of the scoop was made every minute; and 65 cu. yd. of gravel could be raised in 12 hours. When the tide failed, men worked the apparatus with a windlass.

Rake Dredger on Danube.[11]—The Danube Steam Navigation Co. removed the shingle in the shallow parts of the river by means of a triangular rake, with wrought-iron sides, 18 ft. long, and fitted with 34 teeth of chilled cast-iron, 12 in. deep. This rake was hung over the bow of the steamer, 180 ft. long by 21 ft. beam, and dragged across the shallows, increasing the depth of water in one instance from 5 ft. 6 in. to 9 ft., after passing over the bank 355 times.

Mr. BERGERON has proposed a combination of the above raft and Mr. LAVALLEY'S injection arrangement, for removing bars, namely, to have nozzles upon the rake, in connection with a force-pump; the jets of water would loosen the sand, and the rake would take it away.[12] The author, however, cannot find any record of a practical application of this arrangement.

SAND-PUMP DREDGERS.

Woodford's Sand-Pump.—One of the earliest applications of pumps for dredging was made by Mr. WOODFORD. It consisted of a horizontal disk, with two or more arms, working in a case, somewhat similar to the ordinary centrifugal pump. The disk was keyed to a vertical shaft, which was driven from above by means of belts, or other gear, coupled to an ordinary portable engine. The pump itself rested on the ground; the suction-pipe being so arranged that water was drawn in along with the sand or mud, the proportions of the two being regulated to suit the quality of the material. The discharge-pipe was rectangular and carried the vertical shaft; the whole apparatus being adjustable, to suit different depths of water. This arrangement was very effective, and has been used with advantage on many works in this and other countries.

Burt and Freeman's Sand-Pump.[13]—This pump is a modification of the "Woodford" Pump, and was used in the construction of the Amsterdam Ship-canal, for which works it was designed. The excavations there had to be deposited on the banks, some distance away from the dredgers; and after being raised by the ordinary bucket-dredger, instead of being discharged into barges, they were led into a vertical chamber on the top side of the pump, suitable arrangements being made for regulating the delivery. The pump was 3½ ft. in diameter, and made about 230 revolutions per minute; it drew up the water on the bottom side, and mixing with the descending mud on the top side, the two were discharged into a pipe, 15 in. in diameter. The discharge-pipe was a special feature in this work, and consisted of a series of wooden pipes, jointed together with leathern hinges, and floated on buoys from the dredger to the bank. In some cases this pipe was 300 yds. long, and discharged the material 8 ft. above the water-level. Each dredger and pump was capable of discharging an average of 1,500 cu. yds. per day of 12 hours. A centrifugal sand pump, designed by Mr. HUTTON, was also used on these works.

Schmidt's Sand-Pump.[14]—This pump is supposed to be an improvement on the system adopted by BURT and FREEMAN on the Amsterdam canal. It was designed by A. W. VON SCHMIDT, and was used for dredging Oakland harbor, California; the dredged materials being deposited on the banks, through floating-pipes, in a similar manner to that employed on the Amsterdam canal. On the latter works, however, the material was first dredged, and afterwards pumped and discharged, thus entailing two distinct operations. In SCHMIDT'S pump those two operations are combined in one in the following manner (Plate 1, Fig. 1). The ground was first cut up by means of a horizontal wheel *A*, 6 ft. in diameter, on the underside of which were attached a number of ordinary plough-shaped cutters, the wheel being driven from above by a vertical shaft, over this cutter a hood *B* was fixed, which just allowed the water to pass underneath; and to the top side of the hood was attached the 20-in. suction-pipe *C*, of an ordinary centrifugal pump, 6 ft. in diameter; the vertical shaft for driving the cutter working on the outside.

For driving the pump, an engine with two cylinders, 16 in. in diameter and 20 in. stroke, running at 134 revolutions per minute, was required. For driving the cutter, an engine with two cylinders, 12 in. in diameter and 12 in. stroke, running at 120 revolutions per minute, was used. The pressure of steam in both cases was from 90 to 95 lbs. per sq. in. The material excavated, consisting of sticky, blue, clayey mud, was discharged through the pipes to a distance of from 500 to 650 yds; the best results being obtained when the proportion of mud to water was about 6½ to 1. The average quantity discharged per day was 1,300 cubic yds. and the maximum about 2,500 cu. yds.

The Bavin Sand-Pump.—Another form of centrifugal-pump dredger is that generally known as the Bavin dredger (Plate 1, Figs. 2, 3, and 4). This machine has been successfully used in France, Holland, and in this country at Lowestoft.[15] The apparatus which was used at Lowestoft was fitted to a boat, 60 ft. long and 20 ft. wide; the pump was 2 ft. in diameter, and had a two-bladed disk. It was originally designed with four blades; but two of them having been broken off accidently, it was found that the pump worked much more satisfactorily without them. The discharge-pipe was 12 in. in diameter, and, when the pump ran 350 revolutions per minute, it was capable of raising nearly 400 tons of sand, gravel, and stones per hour; but the average work was about 200 tons per hour. The engine had two cylinders, 9 in. in diameter and 10 in. stroke, and made 120 revolutions per minute. The pump could work in any depth from 7 to 25 ft. The most satisfactory results were obtained when working in sand or gravel; clay being too stiff for the pump to take up, and soft silt, being diluted with water, would not settle in time, and ran in suspension over the sides of the hopper barges. The best proportion of water to sand was found to be about 5 to 1.

A very important addition was made to the disk by Mr. BALL, who, after trying several devices for protecting the disk and increasing the efficiency, secured a piece of thick india-rubber to the working face with very successful results.

In this, as in most other sand-pumps, it was found advisable to work it by belting, and not by gearing, for when the pumps got choked, and suddenly pulled up, the belt would yield, and so prevent any damage to the machinery.

Kennard's Sand-Pump.[16]—This arrangement is entirely different from those already described, and is a direct application of the ordinary lift-pump (Plate 1, Fig. 5). A wrought-iron box, *A*, has a suction-pipe, *B*, fitted at the bottom, rising about half-way up the inside of the box. On the top of the box is fitted the actual pump *C*, and the flap valves *D D*. This apparatus was used principally in India for excavating the inside of bridge cylinders when sinking them. The apparatus was lowered by chains, and the pump actuated from above; and as soon as the box, *A*, was filled with sand, it was raised, the catches, *E E*, holding up the bottom released, and the contents discharged into a punt.

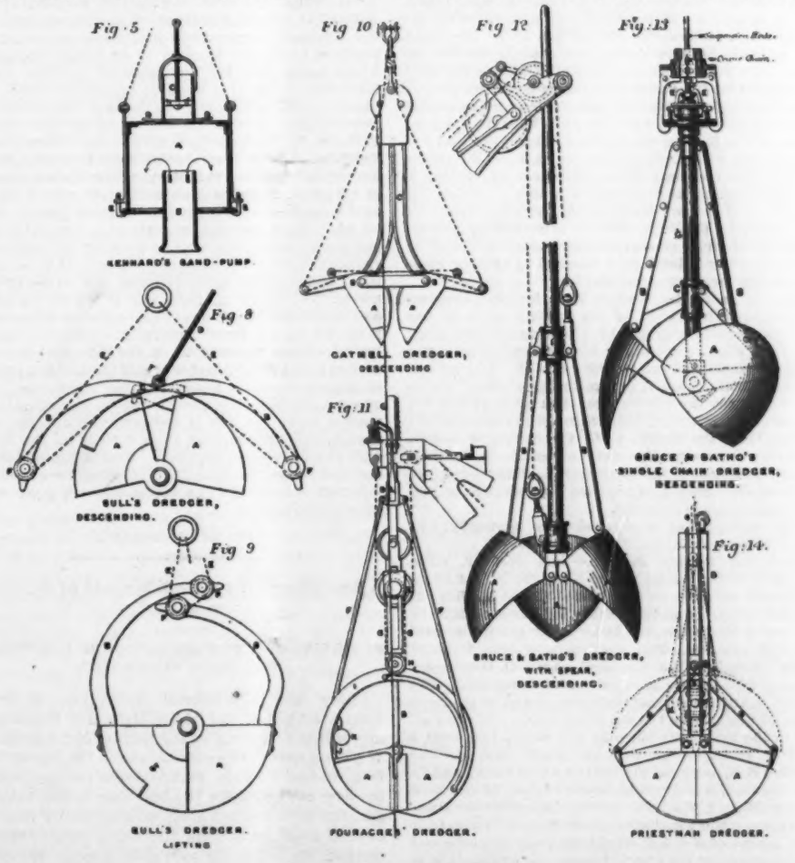

Plate II.—Dredging Appliances.

9 Ibid., vol. lvi. p. 236.

10 Minutes of Proceedings Inst. C. E. vol. xl. p. 318.

11 Ibid., vol. ix. p. 367, and Plate 17.

12 Ibid., vol. lviii. p. 122.

13 Minutes of Proceedings Inst. C. E., vol. lxii. p. 23, and Plate 3, Figs. 7–9; and "Engineering," July 17, 1868, and Nov. 8, 1872.

14 Transactions of the American Society of Civil Engineers, 1884, p. 9.

15 Minutes of Proceedings Inst. C. E. vol. lxxxvii. p. 257; and Institution of Mechanical Engineers. Proceedings. 1882. p. 100.

16 Minutes of Proceedings Inst. C. E. vol. xxviii pp. 294, 297, 303, and Plate 16, Fig. ; and vol. liv. p. 77.

DIP OR BUCKET DREDGERS.

The origin of many of these machines simply the action of an ordinary navvy's spade, and the one most like it is the Indian native "Jham" [17] (Plate I, Fig. 6). This apparatus was used in India for excavating the inside of bridge cylinders. It consists of a large spade, *A*, about 2½ ft. deep, and 2 ft. wide at the top. Into the top of the spade was fixed a handle *B*, which was also secured to the spade by a rod *C*. The native stood with his feet on the top of the spade, holding the handle, *B*, firmly in both hands, and dived to the bottom, the spade entering into the ground. After pushing it in as far as his breath would permit him, he rose to the surface, and rested on a plank suspended from the top. The jham was then hauled up by a rope *D*, and the contents discharged. This primitive method of dredging has been superseded by many ingenious appliances, of which the principal ones will now be described.

Ives's Excavator.[18]—This excavator consists of a long weighted spear with a sort of large spade at the end of it. The spade is hinged at the top, and is capable of being turned at right angles to the spear, a chain being attached to the end of the spade for that purpose. The operation consists in driving the spade into the ground, and after releasing the catch which holds it in position during its descent, the spade is drawn up, at right angles to the spear, by the chain, carrying the material along with it, and is then raised to the top and discharged.

Milroy's Excavator.[19]—This apparatus has been extensively used, both in this country and in India, for excavating in bridge cylinders. Its action is very similar to that of Ives's excavator; but instead of having only one spade, it generally has eight, hinged to the periphery of an octagonal iron frame fixed to a central vertical rod. When these eight spades are drawn up by means of chains, at right-angles to the central rod, they form one flat table, or tray. In operation, the spades hang vertically, and are dropped into the material to be excavated; the chains are then drawn up, and the table thus formed holds the material on the top, which is lifted and discharged by releasing the spades. This excavator was successfully used in sinking the cylinders for the Glasgow bridge.

The Clam-Shell Dredger.—This apparatus has been used to a large extent in America, both for dredging and for excavating in bridge cylinders.[20] It is different in its action from those previously described, and consists of two buckets, *A A*, which, when closed, form one semi-cylindrical bucket. There are many devices for opening and closing the buckets, but the one shown in Plate I, Fig. 7, has been commonly adopted. The buckets are hinged to a side frame, *B*; at *C*, and at *D*, on each end of the bucket, is a pin carrying one end of the link *E*, the other end of the link fitting on the pin of the sliding block *F*, which slides in the slot of the side frame *B*. Joining these blocks, *F F*, is a cross-head *G*. On the bottom of the frames, *B B*, a shaft works, carrying the three pulleys, *H, I, H*; a chain is fixed to the cross-heads, *G G*, and passed round the pulleys *H H*, and a chain passed the opposite way round the pulley *I*. The action of the machine is as follows: The buckets are held open by chains attached to the top of the cross heads *G G*, and the machine is dropped on the top of the material to be dredged. The chains holding the buckets open are then released, the spears are held firmly in position, and the chain round the pulley *I* being drawn in, winds the chains round the pulleys *H H*, which in turn pull down the cross-heads *G G*, and so close the buckets by means of the links *E E*.

This dredger is a very useful machine, and is the origin of a number of appliances which have been since designed. It is also used in America for elevating grain.

Bull's Dredger.[21]—This dredger has been extensively used in India for dredging, and for excavating in bridge cylinders (Plate II, Figs. 8 and 9). It is somewhat similar in action to the clam-shell, but simpler in its arrangement. The buckets, *A A*, when closed, form a semi-cylindrical bucket, and have the curved wrought-iron arms, *B B*, fixed to each end. The buckets are held open by the catch *C*, which can be released by the rope *D*. The hoisting chain, *E*, passes round the pulleys, *F F*, at the end of the curved arms, *B B*; so that when the bucket has been dropped on to the material, the catch is released, and by hoisting the chain *E*, the ends of the curved arms are drawn together, and so close the bucket with the material inside, which is then drawn up and discharged.

Gatmell's Excavator.[22]—As Bull's dredger was found to be ineffective in dealing with clay, a foreman excavator, named GATMELL, devised an apparatus to overcome this difficulty.[23] This was simply a combination of the jham and Bull's dredger. The two special shaped jhams, *A A*, were hinged at *B B*, back to back, a heavy frame *C*. The apparatus is shown in Plate II, Fig. 10, in the act of descending; the sharp points of the jham are driven into the clay by the great weight of the apparatus, and then by hauling up the lifting-chains, which are arranged as in Bull's dredger, the jhams assume a horizontal position.

Fouracres' Dredger.—This apparatus consists of two segmental scoops or buckets, *A A*, hinged to a cross-head which, in the dredger used for soft silt or sand, is attached to the lifting-chain, and, in the machine for stiffer material, (Plate II, Fig. 11), to two wrought-iron spears, *B B*, terminating in the spears, *C C*. Two metal collars, *D* and *E*, slide freely on the spears, the upper one being connected to the buckets by the light iron rods *F F*, and the lower one by the chains *G G*. One end of these chains is connected to the lower collar, and the other, passing through one of the sheaves *H*, is attached to the end of the angle-irons *I I*. These chains cross each other, and, when drawn up, tend to close the buckets, the angle-irons, *I I*, passing each other. These angle-irons slide against a friction-roller on the same pin which carries the pulleys *H H*. The main lifting-chain is wove round the sheaves inside the collar *E*, in the type shown; but in the dredger for light material it is fixed direct to the cross-head. Stops, *J J*, are provided to prevent the buckets from going too far back and getting jammed. The two buckets are held open by the floating catch *K*; and at the jib-head are two catches with sloping faces, which allow the clutch collar, *D*, to rise past them, afterwards preventing it from descending, and so take the whole weight of the bucket. In the small dredgers, the catch is released by hand; but in the large ones, it is worked by a small compressed-air or steam cylinder, and the spears, *C C*, are retained by a clutch-rack actuated by another compressed-air or steam cylinder.

The action of the dredger is as follows: the two buckets being held back by the floating catch *K*, the whole apparatus is dropped to the surface of the mud; this blow slightly opens the buckets and releases the catch *K*, when, through the action of the floating ball attached to the catch, it is thrown out of gear. In the large dredger, the spears are then gripped and the lifting chain tightened, when, through the action of the sheaves and the chains *G G*, the bucket is closed, gradually enclosing the mud or sand. It is then raised, until held by the clutches *L L*, which, when the apparatus is lowered, caused the buckets to open, and so discharge their contents.

This dredger has been used very successfully in India on the Patna Canal[24] and other places.

Bruce and Batho's Dredger.—This dredger, when closed, is of the hemispherical form, the bucket being composed of three or four blades (Plate II, Figs. 12 and 13). It can be worked either by a single chain, or by means of a spear, the latter being generally used for stiff material. The advantage of this form of dredger bucket is that the steel points of the blades are well adapted for penetrating hard material. The blades, *A*, are opened and closed by means of the rods, *B*, which are attached to the cross-head, *C*, at one end, and to the top of the blade at the other, and form a kind of knuckle-joint with the inside rods *D*. The catches, *E E*, sustain the bucket when open; and in this position, it is dropped to the surface of the mud or clay (Plate I, Fig. 12). Several ingenious arrangements are made for closing these blades: in Fig. 13, it is by means of a rod *F*, working inside the tube rod *G*, and actuating the knuckle levers *D*. In Fig. 12, it is by means of two chains actuating alternately the bottom and top cross-heads *H* and *I*, the spear being retained by a lever and cam arrangement, *J*, at the cross-head.

These dredgers have been used in many places, giving most satisfactory results with all kinds of material. On one occasion, in the author's experience one of these dredgers brought up a 70-lb. rail, 32 ft., long, from the bottom of a dock.

Priestman's Dredger.—This dredger bucket[25] is of the clam-shell type, and is opened and closed by a similar arrangement to that already described; but Messrs. PRIESTMAN have devised a very neat arrangement for workingg and lifting, and opening or closing chains (Plate II, Fig. 14). The cross-head, *C*, works freely in the wrought-iron frame *D*, and to it are attached the chains *E E*, which are wove round the drums *F F*; and to the top of the cross-head is attached the opening chain, G, which is passed over the jib-head to a combination of sheaves which take up the slack. The lifting chain is wound round the large drum *H*; and after the bucket has been dropped on the top of the mud, being held open by the chain *E*, the act of tightening the lifting chain turns the drum *H*, which turning the drum *F*, draws the cross-head, *C*, down thus closing the bucket.

This apparatus gives very good results for mud, gravel, and soft sand, and is also used for grain; but it cannot excavate hard sand or stiff clay, which is the general defect of this class of dredgers, unless they are not entirely dependent upon the force of the blow in falling, and the weight of the apparatus, for the penetration and grip of the material. A dredger of this type, with a bucket capable of holding one ton of mud, when working under the author's superintendence, dredged during six days, in 19 ft. of water, an average of 52¾ tons, and a maximum of 68½ tons per hour: and during twelve days, in 16 ft. of water, an average of 48 tons, and a maximum of 58 tons per hour; at a cost of 1.63*d.* per ton, exclusive of cost of discharging, interest on capital, and depreciation.

Duckham's Pneumatic Dredger.—Mr. F. E. DUCKHAM, M. Inst. C. E., engineer to the Millwall Dock Co., has introduced a system of discharging the dredged material, which has been successfully adopted at the Millwall Docks and elsewhere. The material after being dredged, is discharged into capacious cylindrical tanks on board the dredger, or on barges alongside. These tanks when full are closed by air-tight doors; air is then forced into them by means of special air-compressing engines, and the dredged material is discharged, either into the sea, or through long iron pipes on to the land. The apparatus used at the Millwall Docks consisted of an ordinary bucket-ladder dredger, 113 ft. long, 27 ft. beam, and 12 ft. deep, with a loaded draught of 8 ft; and two cylindrical tanks were placed one on each side of the well, having a combined capacity of 240 cu. yds. The same engines were used for either propelling the vessel, dredging or working the pneumatic cylinder; they were compound engines of 25 nominal H. P.; and the pneumatic cylinder was 20-ins. in diameter. The discharge-pipe was 15-ins. in diameter, and 150 yards long, the pneumatic pressure being about 15 lbs. per sq. in. From experiments made with one of the apparatus constructed on the above principle, the author found that, with clay or stiff mud, if the nozzles of the air-injection pipes were too small, the compressed-air, instead of driving out the material, simply pierced holes through it, escaping through the discharge pipe, and carrying along with it all the liquid and thin material in the tanks. This defect was easily rectified by re-arranging and increasing the size of the injection nozzles, and the apparatus now gives most satisfactory results.

[TO BE CONTINUED].

Remarks on the "New Method of Dimensioning."

BY WM. CAIN, PROF. OF MATHEMATICS AND ENGINEERING, SO. CAROLINA MIL. ACADEMY.

I have read with interest Mr. ALFRED D. OTTEWELL'S article on the "New Method of Dimensioning, which, following on the heels of Mr. JOSEPH M. WILSON'S recent "Specifications for the Strength of Iron Bridges" for the Pennsylvania railroad (where the new method is for the first time in this country adopted in a general specification) shows that increased attention is being directed to this systematic method for obtaining safe unit stresses for every part of a structure of any kind, and that in all probability it will, with perhaps slight modifications, be the method of the future for dimensioning.

It is well therefore, to carefully scrutinize any formulæ that may be proposed, since they must necessarily be to a large extent of an empirical nature, and to compare them with the collective experience of the profession as far as that can be ascertained.

As regards Mr. OTTEWELL'S formula (*A*) giving the safe working stress per square inch for tension, I think that for iron, the extremes are too far apart. Granting that mechanical engineers, for an all live load, subject to great shocks, would use only 4,000 to 5,000 lbs. per sq. in. for rods in tension, is the very reason why bridge engineers should use a slightly greater lower limit for those members that are suddenly strained from nothing to their maximum, for in a bridge properly built, with all the connections properly fitted and the track and train in good order, the hurtful effects of shocks and vibrations, that we can class generally under the head of *impact*, can hardly be so serious as in a machine where the jars are so much more direct and violent.

It is true that those engineers who allow 7,500 lbs. unit stress on a "counter" will require a "floor-

17 Ibid, vol. xxviii. p. 325, and Plate 16, Figs. 1 and 2.

18 Minutes of Proceedings Inst. C. E. vol. xxxix. p 214, and Plate 12, Fig. 5–9.

19 Ibid., vol. xxviii. p. 326, and Plate 17

20 Ibid, vol. lxiii. p. 265, and Plate 12, Figs. 1–10.

21 Minutes of Proceedings Inst. C. E. vol. xxxix. p. 213, and Plate 12, Figs. 1–4; and vol. liv. pp. 65, 83.

22 Ibid., vol. lxv, p 248, and Plate 3, Fig. 6–10.

23 Ibid, vol. xlviii. p. 103.

24 The leading dimensions of a Fouracres' dredger working on the Patna canal are: Length, 80 ft., breadth, 15 ft., depth 4 ft., mean draught 1¾ ft. nominal H. P. 6, capacity of bucket, 16 cub. ft., greatest depth to dredge, 8 ft.; and the average quantity dredged per day with the machine was 135 cub. yds.

25 Minutes of Proceedings Inst. C. E. vol. lxv. p. 310, and Plate 5.

beam hanger" to have 25 per cent. greater section than that stress will call for, but it can be said that they probably receive more direct shock than a counter, which is generally taut, whereas a hanger may not be, besides the breaking of a hanger is a more serious matter than the breaking of a counter; for in the first case the bridge is undoubtedly wrecked, whereas in the latter case, the stiffness of the upper chord and bracing may prevent a catastrophe. Just here I should like to inquire whether any experiments upon the breaking strength of hangers, of the usual forms have been made, and the results published?

The formula that I proposed 10 years ago for safe unit stress for tension in the case of iron, and that has been adopted by Mr. WILSON for double rolled iron in links or rods, is

$$a = 7{,}500\,(1 + \theta) \qquad (1)$$

where $\theta =$

$$\frac{\text{minimum stress on member}}{\text{maximum stress on member}} = \frac{min.\ B}{max.\ B}$$

Mr. WILSON properly replaces the 7,500 by 7,000 for plates or shapes (rolled iron) and by 6,500 for rolled iron in compression.

It was manifestly inexpedient to enter into such detail when the method was first proposed.

In the above formula, I allowed empirically for impact and as it has been thought by some that the modification of the original LAUNHARDT formula was possibly in the wrong direction for impact, I shall take this opprtunity to make clear the exact value of the term representing its influence, and to show moreover, that the formula has as a basis, LAUNHARDT'S formula, which represents the known results of repeated stresses without shock, and is therefore important as a basis for any formula that may be devised, as reducing the empirical to that extent.

WEYRAUCH (Structures of Iron and Steel," Wiley & Sons, Chap. XIII) deduces from LAUNHARDT'S formula, by aid of the WÖHLER experiments, the following expressions for the stress that will just break a bar of iron subjected to simple tension after an indefinite number of repetitions (10,000,000) between the limits of stress *min. B* to *max. B*,

$$a = 30{,}000\,(1 + \tfrac{1}{3}\theta) \qquad (2)$$

θ having the value given above, a is expressed here in pounds per square inch. The iron was evidently not of very good quality for it broke under a single application of a load gradually applied ($\theta = 1$) at 45,000 lbs.; likewise for an indefinite number of applications of a load of 30,000 lbs., the stress varying from 0 to this maximum, the bar again broke.

Now, if a train could glide across a bridge as smoothly as a skater does on ice, causing little or no shock or vibration, I take it that formula (2) will give the breaking stress, for any member of the bridge, for a very large number of repetitions of the passage of the train quickly repeated. So far the formula is good, and it should be utilized if possible, when the impact, such as a train causes in passing, is likewise considered; though it will then have to be modified emprically for probably no future experiments will ever enable us to do this exactly.

The simplest supposition, and one that will probably always be used, no matter if future experiments show that it is not absolutely exact, is that the effect of impact should be to decrease the unit stress for rupture as θ decreases, for as the live load increases in proportion to the dead, it is natural to suppose that the effect of impact is greater.

If we allow then as the effect of impact in decreasing the unit stress for rupture the expression,

$$I = c\,(1 - \theta) \qquad (3)$$

we see that for all dead load ($\theta = 1$) that $I = 0$, and that for all live load $\theta = 0$) $I = c$, its maximum and that for intermediate values of θ that I varies proportionally.

This formula then satisfies the extremes (as is imperative) and gives the most reasonable determination of intermediate values, so that it can be used in all cases, as supplying a proper value to the constant c.

Well, I shall arbitrarily, for bridge members make this constant $c = 7{,}500$; so that I assume for a counter, say with no initial stress on it, that it will break with 7,500 lbs. less from the effect of the impact of the train than if the train could glide without shock over the bridge, allowing, say for 40,000,000 repetitions of the load.

On subtracting this effect due to impact from eq. (2), we derive for the breaking stress, impact included,

$$a' = 22{,}500\,(1 + \theta) \qquad (4)$$

and for a factor of safety 3, the safe stress that can be allowed,

$$b = 7{,}500\,(1 + \theta) \qquad (5)$$

It is now seen that formula (1) was really derived in the way mentioned, and that it fully includes all the experimental results given by LAUNHARDT'S formula and accounts in the simplest way for impact. There is evidently a choice for the constant c, as it is simply a matter of judgment for each individual engineer.

Formula (2) of LAUNHARDT for a factor of safety 3 gives the safe stress, impact not considered,

$$\frac{a}{3} = 10{,}000\,(1 + \tfrac{1}{2}\theta)\ lbs.\ per\ sq.\ in. \qquad (6)$$

from which we see that the safe stress according to LAUNHARDT varies from 10,000 lbs. for all live load to 15,000 lbs. for all dead load.

From formula (5) we see that, impact included, the safe stress varies from 7,500 for all live load to 15,000 for all dead load.

By subtracting (5) from the one just above we see that the effect of impact on *safe* stress has been taken at,

$$2500\,(1 - \theta)\ lbs.\ per\ sq.\ in.$$

LAUNHARDT, to allow for impact actually diminished the coefficient of θ in (6), or rather an analagous formula, thus allowing greater unit stresses where shocks occurred there before. WEYRAUCH has criticised this procedure in Chapter XXIX of his "Structures, etc."

We hope now that it has been made plain that our method of allowing for impact is to a certain extent correct in principle, and can be represented by a simple expression (3) for all cases. that is easily understood and can be applied by any one in the future, having regard to new experience or direct experiment. The only experiments that bear on the subject that I am acquainted with, are given in Stoney on Strains (1873 ed.) Chapter XXVIII, where it is seen how little the strength of a cast-iron beam in a bridge is dependent upon the quiescent load and how largely it is influenced by impact.

Not so much is said about wrought-iron, save the notable experiment by Sir WILLIAM FAIRBAIRN on "a wrought-iron single-webbed plate girder with double angle irons and flange plates riveted on top and bottom respectively." The girders was 22 ft. long, depth 16-ins, and to imitate as far as possible the passage of heavy trains a weighted lever was lifted off and replaced alternately by means of a water wheel. After a million repititions for a tensile stress per sq. in. on the net area of the bottom flange of 7 tons and less without injury, the deflection at the center was increased, so that the above unit fibre stress was 9.36 tons when after 5175 repetitions the girder broke by the bottom flange tearing across near the middle. Unfortunately the quiescent breaking unit stress of the iron was not obtained but Stoney assumes it at 20 tons, so that the actual stress necessary for rupture was about one-half the quiescent which is agreeable to formula (4) above. The second unsatisfactory experiment with the same girder made it less. It is very likely that the conditions here were more severe than would be caused by a train in motion over a bridge. Referring to the Niagara Falls Suspension Bridge Mr. ROEBLING observes—"In my opinion a heavy train running at a speed of twenty miles an hour, does less injury to the structure than is caused by twenty heavy cattle under a full trot. Public processions marching to the sound of music or bodies of soldiers keeping regular step, will produce a still more injurious effect." Is this not a sufficient reason for using no lower unit stresses on highway bridges than for railroad bridges.?

Let us now ascertain what allowance for impact alone is really included in Mr. OTTEWELL'S formula (A), using the value $u = 5{,}000$ lbs. for double rolled iron in tension.

On substracting from (6), the formula of LAUNHARDT (as we shall call it for convenience) where impact was not regarded, the expression

$$5{,}000\,(1 - \theta)$$

we are conducted at once to formula (A), so that $5{,}000\,(1 - \theta)$ represents exactly what Mr. OTTEWELL has allowed for impact; his formula includes the deduction of LAUNHARDT, minus this allowance (when safe stress is taken) for impact. If the breaking quiescent load is given (by (2) for $\theta = 1$) at 45,000, then for an all live load Mr. OTTEWELL would allow $3 \times 5{,}000 = 15{,}000$ lbs. per sq. in. for breaking stress for impact alone, which certainly looks excessive for wrought-iron.

The relative amounts allowed for impact are shown on the diagram given on p. 310 of ENGINEERING NEWS. Thus the lines drawn from 10 on the left vertical to 15 on the right vertical marked "WEYRAUCH" (as it is really WEYRAUCH'S formula for simple tension or simple compression alone) represents formula (6) above, where repetiton of stress but not impact, is alone regarded. The difference between the ordinates to this line and those marked "CAIN and WILSON (1)" and "formula (A)" show exactly the amount estimated for impact by the respective formulæ.

It is well known that a train in motion will generally cause a greater maximum deflection than the same train at rest on a bridge.

Now, if we assume that the stresses in the members are directly proportional to the deflection at the center (which is nearly so since deflection varies directly as the weight), the increased deflection due to motion, ought to give us some idea of the effect of impact and should be, approximately at least, the measure of it.

Therefore, it will be very instructive to ascertain *what per cent. of the live load is added for the increased deflection due to motion of the train*, when we use formula (1) for unit stresses.

It will be most convenient though first to determine the per cent. of total dead and live load on truss that is allowed for impact and for simplicity, we shall consider only a lower chord member.

Thus let

A — Stress in lower chord member due to weight of bridge.

B — Stress in lower chord members due to train alone when at rest on truss.

Bp — Increased stress due to impact.

$(A + B)\,p_o$ — Increased stress due to impact, where p is the fractional part of the *live load only* that would be equivalent in its effect to impact and p_o, the fractional part of the *live and dead load* together likewise equivalent to impact alone. We evidently have

$$Bp = (A + B)\,p_o$$

whence,

$$p = \frac{A + B}{B}\,p_o = \frac{1}{1 - \theta}\,p_o \qquad (7)$$

since $\frac{A}{A + B} = \theta$, and $1 - \frac{A}{A + B} = \frac{B}{A + B} = 1 - \theta$.

The quantity p can likewise be regarded as the *part* of the whole deflection at the center, due to live load only at rest on the bridge, which is superadded when the train is at its usual maximum speed; and p_o is the similar fractional part of the total deflection due to weight of truss and train at rest on it, superadded when the train is in motion.

By assumption therefore, the stress on a lower chord member increases from A to $(A + B)\,(1 + p_o)$; so that if we term,

$$\theta' = \frac{A}{(A + B)\,(1 + p_o)} = \frac{\theta}{1 + p_o}$$

we have the section of the member given by LAUNHARDT'S formula (6) for an indefinite number of repetions,

$$\frac{(A + B)\,(1 + p_o)}{10{,}000\,(1 + \frac{1}{2}\theta')}$$

In this case the effect of impact has been included in the total stress $(A + B)\,(1 + p_o)$, and the unit stress in the denominator therefore we should only provide for the effect of repitition which LAUNHARDT'S formula profes es to do.

Now to get the sectional area by use of formula (1), which professedly includes the effect of repetition, as well as impact. we more simply divide $(A + B)$ by the unit stress, thus obtaining for the section,

$$\frac{A + B}{7{,}500\,(1 + \theta)},$$

the value θ simply referring to the extremes A and $A + B$.

By placing these two expressions equal, we shall

ascertain what value of p_o and ultimately of p, has been tacitly used in (1) for given values of θ.

We have therefore,

$$\frac{(1+p_o)}{10{,}000\,(1+\frac{1}{2}\theta^2)} = \frac{1}{7{,}500\,(1+\theta)} \qquad (8)$$

On substituting for θ^2 its value above $\frac{\theta}{1+p_o}$, and solving the quadratic we readily derive,

$$p_o = \frac{-(1+3\theta) + \sqrt{2\,(2+3\theta+3\theta^2)}}{3\,(1+\theta)} \qquad (9)$$

The upper sign of the radical being taken as p_o cannot be negative.

In the table below the values of p_o and afterwards p (by aid of (7)) are given for various values of θ corresponding to the spans given in the first column for American bridges:

TABLE I.

Span in feet.	θ	$\frac{1}{1-\theta}$	p_o	p
20	.10	1.11	.26	.29
30	.13	1.15	.24	.28
40	.15	1.18	.23	.27
50	.17	1.20	.22	.26
60	.19	1.23	.21	.26
70	.20	1.25	.20	.25
80	.22	1.28	.19	.24
100	.25	1.33	.18	.23
125	.28	1.39	.16	.22
150	.32	1.47	.15	.22
175	.35	1.54	.14	.21
200	.38	1.61	.12	.19
250	.43	1.75	.11	.18
300	.49	1.96	.09	.18
350	.55	2.22	.07	.16
400	.60	2.50	.06	.15
450	.65	2.86	.05	.14
500	.70	3.33	.04	.13

The columns headed p_o and p show respectively the percentages to add to live and dead loads together, or to live load alone, so that if we use LAUNHARDT'S formula (6) for unit stresses, we shall get the same results we obtain by regarding the maximum stress as $(A+B)$ and applying formula (1).

If, in place of using LAUNHARDT'S formula in the first case, we employ the usual 10,000 lbs. per sq. in., we readily obtain, comparing it with the method which employs eq. (1),

$$p_o = \tfrac{1}{3}\cdot\frac{1-3\theta}{1+\theta};$$

whence we derive the following percentages in order that the two methods agree,

For $\theta = 0$, $p_o = .33$, $p = .37$
" $\theta = .1$, $p_o = .21$, $p = .37$
" $\theta = .2$, $p_o = .11$, $p = .14$
" $\theta = .32$, $p_o = .01$, $p = .01$
" $\theta > .33$, $p_o = 0$, $p = 0$.

(TO BE CONTINUED).

PUBLICATIONS RECEIVED.

Sixth Annual Report of the Railroad Commissioners of Alabama, for the year ending June 30, 1886. This neatly bound volume resembles very much many other "public documents" of the kind, in that it is unnecessarily bulky in reprinting the separate reports, while it omits those careful summaries which are the most valuable parts of such publications. Most of the book is taken up with reports of the various roads in the State, giving their capital stock, debt, trackage, equipment, analyses of earnings and operating expenses, general result of the operation of the road, and report of accidents for the year. No attempt is made to summarize the information thus obtained.

The commission have refrained from meddling with technical matters of any sort, probably because they were more familiar with Blackstone than Weisbach. Only once do they venture to suggest that the rails of a certain road are "much laminated." The main points that have engaged their attention have been the providing of proper station accommodations and the reduction in freight and passenger tariffs. "Exhibit D" is a showing of the reduction in rates made on several roads since the establishment of the commission. Sixteen roads have reduced their rates one to two cents per mile. This, the commissioners declare, effects a saving to the people of Alabama of nearly three-quarters of a million dollars per year; and they estimate a saving of half a million by lower freight rates.

One case of "turned tables" is quite amusing. The Western Railway of Alabama protested against a reduction of its passenger tariff to three cents, saying that it would prevent "a fair return from the investment in said property." After discussing the matter pro and con, the commission declare that in estimating the real value of the line (which is the proper method of ascertaining what actual capital is in existence as represented by the road) no fairer valuation can be made than the company's officers' own estimate, sworn to by them upon the occasion of the appraisal for taxation purposes. This makes the *net* income of the road a little over 12½ per cent., which the commission says, as 8 per cent. is the legal rate of interest in the State, "should be considered a fair and just return on the value of the property." The Commission's point, however, is more neat than true. It does not follow because the interest rate on loaned money is 8 per cent. that risky business investments are not entitled to much more if they can get it.

The Commission seems to have done work fully up to the average, and while it is to be regretted that it is no better, so long as railway commissions are made up of men whose previous experience has lain wholly outside of the field of railway management and technique, we must not expect too much.

The Weather of the United States for the Month of June, 1887.

[As respects the elements of most interest to engineers.]
According to special returns from the Chief Signal Officer of the U. S. Army.

STATION.	Temperature. Degrees Fah.				Wind Velocity. Miles per hour.			Precipitation. Rain and melted snow. Inches.		
	Average	Max.	Min.	Range.	Average	Max.	Direction. Max.	Total.	Heaviest in 24 hours.	No. rainy days.
Northern Cities.										
Northfield, Vt.	63.0	82.2	39.8	48.4	7.1	27	E	4.12	1.06	12
Portland, Me.	61.5	86.6	43.3	45.3	7.7	27	S	4.07	1.39	14
New York City.	68.2	90.1	51.3	38.8	6.1	24	SE	7.70	3.00	11
Pittsburg, Pa.	72.2	93.9	52.2	41.7	5.2	24	SW	4.50	1.64	12
Chicago, Ill.	67.3	96.4	47.9	48.5	9.4	34	W	1.63	0.70	7
Omaha, Neb.	72.4	94.	49	45.0	8.1	30	N	4.56	1.00	14
St. Paul, Minn.	69.6	89.6	58.3	41.3	5.4	38	W	2.89	0.87	8
Duluth, Minn.	55.4	83.0	36.1	46.9	5.1	26	NE	2.71	1.61	13
Bismarck, Dak.	68.5	96.8	38.5	58.3	6.0	39	S	0.85	0.39	11
Average.	66.5	91.2	45.2	46.0	6.7	29.9		3.67	1.30	11.3
Southern Cities.										
Washington City.	72.1	94.0	50.1	44.6	4.7	18	E	2.99	1.58	10
Louisville, Ky.	75.4	96.5	52.6	43.9	6.4	24	SW	1.79	0.73	8
St. Louis, Mo.	77.3	97.0	57.2	39.8	6.8	24	S & N	2.54	0.70	10
Savannah, Ga.	77.1	86.6	69.2	17.4	6.9	22	NE	10.76	6.10	12
Leavenworth, Kan.	73.3	95.8	51.0	44.8	5.9	20	SE	5.43	1.63	14
Jacksonville, Fla.	77.9	95.1	64.1	31.0	6.5	28	S	9.68	3.01	15
Chattanooga, Tenn.	74.2	86 0	64.0	22.0	4.4	30	SW	2.18	0.76	13
New Orleans, La.	78.3	86.2	72.5	13.7	7.0	26	NE	11.33	5.00	11
Memphis, Tenn.	77.0	96.6	55.5	41.1	4.6	24	SW	1.04	0.37	10
Palestine, Tex.	77.1	88.7	68.5	2.02	6.4	36	NE	2.57	1.10	8
Average.	76.0	92.3	60.5	31.8	6.0	25.2		5.03	2.10	12.4
Far Western Cities.										
Helena, Mont.	57.6	83.4	33.0	50.4	7.3	40	NW	3.48	1.06	13
Port Angeles, W. T.	52.2	79.8	35.1	44.7	6.6	24	W	1.12	0.50	9
San Francisco, Cal.	58.0	90.0	48.5	41.5	12.6	36	W	0.07	0.07	1
Salt Lake City, U.	68.7	97.3	44.5	52.8	6.5	36	S	0 37	0·22	3
Denver, Col.	69.3	95.9	43.7	52.2	8.2	42	N	0.53	0.15	5
Yuma, Ariz.	86.9	115.5	59.4	56.1	6.7	25	W & SE	0.01	0.01	1
Santa Fé, N. M.	65.6	85.5	48	37.5	3.1	25	E	0.60	0.22	9
Average.	65.3	92.5	44.1	47.9	7.3	32.6		0.88	0.32	5.7

TECHNICAL NOTES.

THE London *Iron monger* states that a few weeks ago the intense heat so expanded some of the rails on the London & Northwestern railway that they became twisted to such a degree as to entirely stop travel. The joints were closed tight before the heat came on, and the matter was remedied by cutting the rails.

HERR KRUPP'S latest "big gun" is to weigh finished 140 tons 14 cwt. Its bore is 15.478 in., and its length is 52 ft. 5.92 in. The shorter and lighter projectile will be 44 in. long and weigh 1631 lbs., while the heavier shot will be 63 in. long and weigh 2314 lbs. An initial velocity of 2148 and 2099 ft. per second is expected from these two projectiles, using brown prismatic powder. If placed near the muzzle of the gun, one plate 45 in. thick, or two plates of 21½ and 23 in. respectively, can be pierced by the smaller projectile. The larger shot will shatter one plate 47½ in. thick, or two plates of 23½ and 24½ in. respectively. The latter represents a mass of wrought-iron nearly 6 ft. thick. The *Kolnische Zietung*, from which the above is taken, says that a gun is to be tried having a bore of 17.7 in., and weight of 147 tons 22 cwt.; this gun will throw a projectile 5 ft. 11 in. high and weighing 3304 lbs.

THE Prefect of the Seine in his annual report for 1886 give among things the following economic statistics of Paris:—The water distribution extends over 600 miles and nearly 4,000,000 million gallons of water were furnished to 66,000 subscribers out of 82,000 house-holders. The Paris Omnibus Co. carried over 191,000,000 passengers, while nearly 50,000,000 travelled by the two main tramway systems. The boats on the Seine carried about 20,000,000 people and nearly 18,000,000 used the circular railway about the city.

As showing the value of land in the City of London we note the recent rental of an area of 2036 sq. ft., with a frontage of 63 ft., at an annual sum of $5,600, or about $2.75 per sq. ft. The lessees were to erect a building upon it costing not less than $35,000.

A CORRESPONDENT of the Lancaster Pa., *New Era*, in commenting on the connection of lightning conductors with water-mains, notes his experience as follows;—In fitting up a lightning conductor on the spire of a church in that city he laid the copper cable in the same trench holding a service-pipe and carried it to and simply wrapped it around the main in the street. The conductor was brazed to a gilded copper finial containing 10 or 12 superficial feet. This finial was soon after struck by lightning during a thunder storm of very unusual intensity and the electric fluid was conveyed to the ground without injury of any kind either to the building or the system of water-mains.

Convention Jots.

The scene of the late Convention of the Americam Society of Civil Engineers, near the reputed home of RIP VAN WINKLE and up on the mountain top—"far removed from the city's heat and turmoil"—has suggested to our artist several sketches herewith presented.

First we have the misguided member who too literally obeyed the well-meant advice of the managing committee and brought "his heavy clothing." The subject of the sketch has perceptibly wilted under the rays of the mocking sun—but he is also mad, and hunts, with vengeful brow and a heavy battery, for the authors of his misery. We might remark here again that the Society seems to have a knack for picking up hot weather in localities where, according to the sworn statement of our host

and the oldest inhabitant, it was before unknown. This annual searching for "a cool, secluded spot, and perspiring because we find it not," is getting to be quite too much the regular thing.

YE ANCIENT HOST OF THE KAATERSKILLS.

The next sketch presents a "retrospective" view of mine ancient host of the Kaaterskills as he might have appeared in the days of good Dietrich Knickerbocker. He is a type of the time hereabouts when engineers were not and people jogged along in a quiet way in strict accordance with their utter abhorrence of all mental and physical gymnastics.

Then comes RIP and his "loving cup," the one he did not count until the seductive schnapps of HENDRICK'S crew laid him away on a rock somewhere down by Sleepy Hollow for a matter of twenty years. So says the legend, and the well-known capacity for rest of the good old Dutchman of those days makes it altogether possible that there was quite as much truth as IRVING-JOE-JEFFERSON in the tale. In any event the faithful guide-maps of the Kaaterskills pilot you to "RIP VAN WINKLE'S House," and the proprietor thereof points out RIP'S rocky couch, duly labelled, the gun he carried and his eventful canteen, and high up in the branches of a near-by tree you can still gaze upon the bones of his faithful dog Schneider. The fact that the gun has a percussion lock and carries a "Tower" stamp, and that Schneider's bones most probably once formed part of the anatomy of a cow, somewhat rudely shakes our faith. But, as the young hopeful of the house confided to us, "Dad's told that yarn so often that he believes it himself"—and so should we.

"VE WON'T COUNT DIS ONE" RIP'S LOVING CUP.

The last sketch shows RIP as he might have appeared had he awakened from his long nap sometime last week and suddenly encountered the "banner with a strange device" that was then first unfurled to the world. The legend vividly paints RIP'S puzzled wonder at the events that had transpired during the twenty years of his slow-going exile. But if we could imagine one of the Am. Soc. C. E. put to sleep for the *next* twenty years, under the potent influence of one of the mint juleps of the Managing Committee, would he be any less astonished in his waking moment than was RIP, by the realization of what are now mere possibilities or the advent of affairs now undreamed of? We think not, if the immediate past is any index of the future.

DUNDER! VAT FLAG IS DAT? WHOT BEEN HERE SINCE I'S BEEN GONE?

CORRESPONDENCE.

On an Incident of the Late Convention.

EDITOR ENGINEERING NEWS:

I noticed in last week's issue of your journal a brief though spirited sketch of the proceedings attending the assembling and opening of the 19th Annual Convention of our Society of Civil Engineers, held at the Hotel Kaaterskill.

The assembling was not without its perils, happily extending no further than about the safe limit to which personal discomfort can be considered as endurable.

Thanks to our Committee of Management, the unforeseen, if not provided for, had an element of compensation about it, or what might be called a a factor of safety introduced which was well worthy their professional standing. The perils of the assembling having thus been met so scientifically, there remained but the ordinary danger inseparable from large masses of heated material in the process of cooling. If natural laws had been relied upon, this seething mass, would in obedience to such, have settled quietly in the order of their gravity, the heavier below, and the lighter floating on the top; and any unbalanced motion remaining in the lighter strata, need not have disturbed the substantial elements of the mass, nor compromised the gravity of that portion which must ever constitute the element by which the stability of the entire body must be measured.

The Convention, as a whole, whether judged by the character of the social element, so happily exhibited, or the professional exercises to which the first served as a proper foil, may be considered as eminently successful, and every way enjoyable, and it is much to be regretted, that at a single stage in the proceedings this should have been marred by the momentary disregard of the fact that amusements are a test of character, in that they are an evidence of tastes and inclinations, and it becomes a thankless task for a member, having the welfare of the Society at heart, to call attention to any occurrence as having taken place tending to lower the dignity which it is fitting and proper should attach itself to a society having the high aims and purposes embodied in our constitution; and it might well be considered, whether silence under the circumstances would not indeed be "golden." I would wish to bury out of sight every putrescible atom of the organism, and certainly shall not call in the public to witness the washing of our soiled linen; but I find it impossible to pass, without some comment, a matter which unfortunately did not grow out of the exuberance of the lighter strata of youth constituting at this day a large proportion of our Society, but was encouraged by, if it did not originate with, men whose locks were sufficiently silvered to have induced a belief that they were not wholly without wisdom.

If there are members of the Society not cognizant of the "Proceeding" to which I allude, (I will not call it a "Transaction,") it would give me pleasure to learn it; but there are a goodly number, it is feared, who will too well understand me when I add, that one might laugh at the poor black who, monkey-like, would imitate, to the best of his limited capacity, what he could understand as the highest performances of his white patron—but can we laugh when we see representatives of a body of men, the peers of any in the world, show so little sense of what constitutes humor, that they can see fun in imitating the imitative pranks of the poor black, and, despairing of making the imitation sufficiently clear to be recognized, must call to his aid, for the completion of the picture, one of the despised race?

I have endeavored to draw this scene with as mild a pencil as possible, having the highest love and respect for many who thoughtlessly engaged in this unseemly revel, and that the mischief may carry with it its own cure, I would quote for the benefit of our young members from the writings of QUINTILLIAN which may be freely rendered thus: "That laughter costs too much which is purchased by the sacrifice of propriety."*

I trust, Mr. Editor, that my motive for these strictures may not be misunderstood, but have its explanation in my jealousy for the good name even in trifles, of the

AM. SOC. C. E.

*"*Nimium risus pretium est, si probitatis impendio constat.*"

A Novel Railroad.

ROCHESTER, N. Y., July 2, 1887.

EDITOR ENGINEERING NEWS:

Perhaps it may interest some of your readers to know that in planning the railroad tracks used in distributing the food of the patients to the several wards of the Buffalo Asylum for the Insane, in order to overcome the difficulties of passing through some of the narrow and crooked passages in the basement of the building through which the cars had to pass, some of which would only allow of curves of 5 ft. radius, (the gauge being 16 ins.) I was led to make the cars, which are 6½ ft. in length, with four wheels only, each pair being situated near the end of the car, turning on their own center-pins, thus serving the purpose of a four-wheel truck under an ordinary car.

These wheels are kept from leaving the track by an extra depth of flange, and in order to facilitate the turning on the sharp curves, the flanges of the wheels are on the outside of the rail instead of on the inside.

As will readily be seen as soon as the flange on the inside of the curve strikes the rail the wheel is impeded, while the wheel on the outside continues on (each wheel being loose on its own axle,) until the truck assumes the direction of the curve, the outside wheel being impeded in its turn when it strikes the tangent.

This, to me novel method of railroad construction, was pointed out and shown to be practicable by a very ingenious mechanic, a patient in the institution, since deceased, who was engaged in making the cars.

Since these cars have worked to a charm, this method of operating might, with equal success, be adopted in mines, factories, work-shops, etc., wherever sharp curves are a necessity, and the rails can be kept free from impediments.

THOS. EVERSHED,
Division Engineer N. Y. Canals.

The Artesian Waters of the Algerian Sahara.

Mention has already been made of the oasis of Oued Rir, south of Biskra in Algeria, and the good work that is there being done by artesian wells. This Oued Rir is a valley lying north and south and beneath it is a great body of artesian water lying about 235 ft. below the surface. Flowing artesian wells are already fed by it to the extent of about 1,000 galls. per second. This water belt has been traced for over 80 miles. It is in fact a subterranean river, not a mere reservoir of water, for it has a perceptible flow to the southward. On the surface of the oasis, however, the watershed in time of rain is towards the north, the two systems being distinct and separated, at this point at least, by thick impermeable strata. The subterranean water is not then, as some suppose, simply an ancient river that has sunk beneath the sands, the old Ighaighar. In its serpentine course beneath the surface it varies in width from 2½ to 8½ miles and at places doubles upon itself or forms an irregular letter X, as in the Ourlana region.

This river has no banks, but simply filters through or cuts through a continuous mass of permeable sand. A correspondent of *Le Genie Civil* believes that as long as wells are located from ½ to 1½ miles apart, a vast increase upon the present supply can be obtained without detriment to wells already sunk. There is doubtless a limit to the supply but experience only can tell when this will be reached. He fortells the creation of new oases outside of the present one, and perhaps far from it, by the further tapping of this aqueous treasure.

New York City.—*Dock Work.*—The following proposals have been received at the Department of Docks for building a crib bulkhead at the foot of E. 76th. St., East river: John Gillies, $8,800; W. Danforth, $4,866. Contract awarded to John Gillies.

Dredging.—The following proposals for dredging at Pier 59, North river, were received at the Department of Docks, July 13: Dubois, 23.9 cts. per cu. yd.; Union Dredging Co., 20 cts. Contract awarded to the Union Dredging Co.

ENGINEERING NEWS

VOL. XVIII. Saturday, July 16, 1887.

D. McN. STAUFFER. A. M. WELLINGTON.
EDITORS.

GEO. H. FROST, - - - BUSINESS MANAGER.

Subscription. – UNITED STATES AND CANADA, $5.00 *per Year; $2.50 for Six Months; $1.50 for Three Months; Single Copies,* 12 *cents.* FOREIGN COUNTRIES, $6.56 *per Year, or* 3 *cents per number additional.*

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THE address of Mr. A. ALLAIN, a draftsman, supposed to be residing in Newark and engaged in New York, is wanted at this office.

THE cause of the appalling calamity at Zug will not be mysterious to engineers, although it may be a useful warning to them, but it is one of the most dramatic and impressive calamities in the history of engineering. The details have so far been painfully meagre, but it is known in a general way that the rock slopes of the lake are very steep and that they were overlaid by a deposit of gravel, sand and mud, on which the piers and other structures along the shores of the lake were founded. On one of the piers, recently built, was a large hotel. Of a sudden, in the middle of the night, the subaqueous foundation began to give way, and in three successive portions, the whole superincumbent mass, piers, hotel, people and all, sank silently and quickly beneath the waves, which closed quietly above them, leaving hardly a sign of the catastrophe which had occurred, and which cost a hundred lives. One soul only escaped, a little infant, which was found many hours afterward, floating asleep in a cradle, probably shoved out through a window while the mass was slowly sinking by those to whom it was dearer than life itself, and whose identity is forever hidden.

All this occurred almost in a moment, and silence reigned after it as before. We recall nothing quite similar, not quite so dramatic, in the whole history of catastrophes. In principle however, it is an old story. The same thing on a smaller scale occurred in building the West Shore Railway near West Point, where a fill which had stood very well the day before completely disappeared during the night, and the attempt to make a fill stand was deemed so hopeless that a long span bridge was put in to cover the opening.

THE late accident at Zug recalls the more startling and much more fatal Goldau calamity of about 80 years ago. This Goldau lies at the other end of the Lake of Zug and is nestled in a valley lying between the Rigi on the one side and the steep Rossberg on the other. Both mountains are made up of conglomerate interstratified with soft sand rock with the strata pitched at a very steep angle. The strata of softer rock disintegrate rapidly on exposure to the air, and at times become so charged with infiltered water that they are squeezed out by the weight above them and descend into the valleys as torrents of mud. This was the case in 1806 when a huge mass of the Rossberg, over one mile long, 1000 ft. wide and 100 ft. thick, slid down from a height of 3000 ft. into the narrow valley, overwhelming with mud and the rocky chaos of superincumbent conglomerate, four villages and 457 of their inhabitants and filling up one-fourth part of the Lake Lowerz. The scarred side of the Rossberg still indicates the path and extent of this great land slide and the Luzerne—St. Gothard railway now passes over the wreck with its huge piles of rock and stagnant pools of water between. The Zug accident was undoubtedly the result of a similar sequence of geological events, the formation being identical, we understand.

MISERY loves company, and it will be something of a consolation to those who are sweltering in various parts of the country with the heat to see from our weather table for June that all are served about the same in all parts of our common country, always excepting that favored spot Fort Yuma, Ariz, where the genial temperature of 115½° in June must have prepared its inhabitants well for what was to come in July, and at a later date. Otherwise, it will suprise many to find how evenly distributed are the advantages of hot weather. The average maximum of North and South are almost exactly the same, but both Chicago, Ill. and Bismarck Dak., show up with a maximum of 99½°, against 86½° only in New Orleans; while the remainder of the table clearly indicates that this is no chance result. The remainder of the table also presents matter of decided interest in respect to rainfall and wind which is well worth study in connection with previous reports, but we prefer to wait for cooler weather before attempting to show why.

IN this connection, as this is hot weather and vacation time, we may relax from our usual scientific severity to quote what the late and ever-to-be-lamented JOHN PHŒNIX (Lieut. DERBY, (U. S. A.) had to say about the climate of Yuma in his instructive "Lectures on Astronomy," which he tells us "were originally prepared in the form of a course to be delivered before the Lowell Institute, of Boston, Mass., but owing to the unexpected circumstance of the author receiving no invitation to lecture before that institution, they were laid aside shortly after their completion." When in the progress of his learned manuscript he reaches the planet Mercury, he says:

> "The day in Mercury is about ten minutes longer than ours; its year is about equal to three of our months. It receives six and a half times as much heat from the sun as we do; from which we conclude that the climate must be very similar to that of Fort Yuma, on the Colorado River. The difficulty of communication with Mercury will probably prevent its ever being selected as a military post; though it possesses many advantages for that purpose, being extremely inaccessible, inconvenient, and, doubtless, singularly uncomfortable."

BESIDES the subscriptions announced in our last issue for enlarging the quarters of the American Society of Civil Engineers the following were made later in the day from among the members present at the convention.

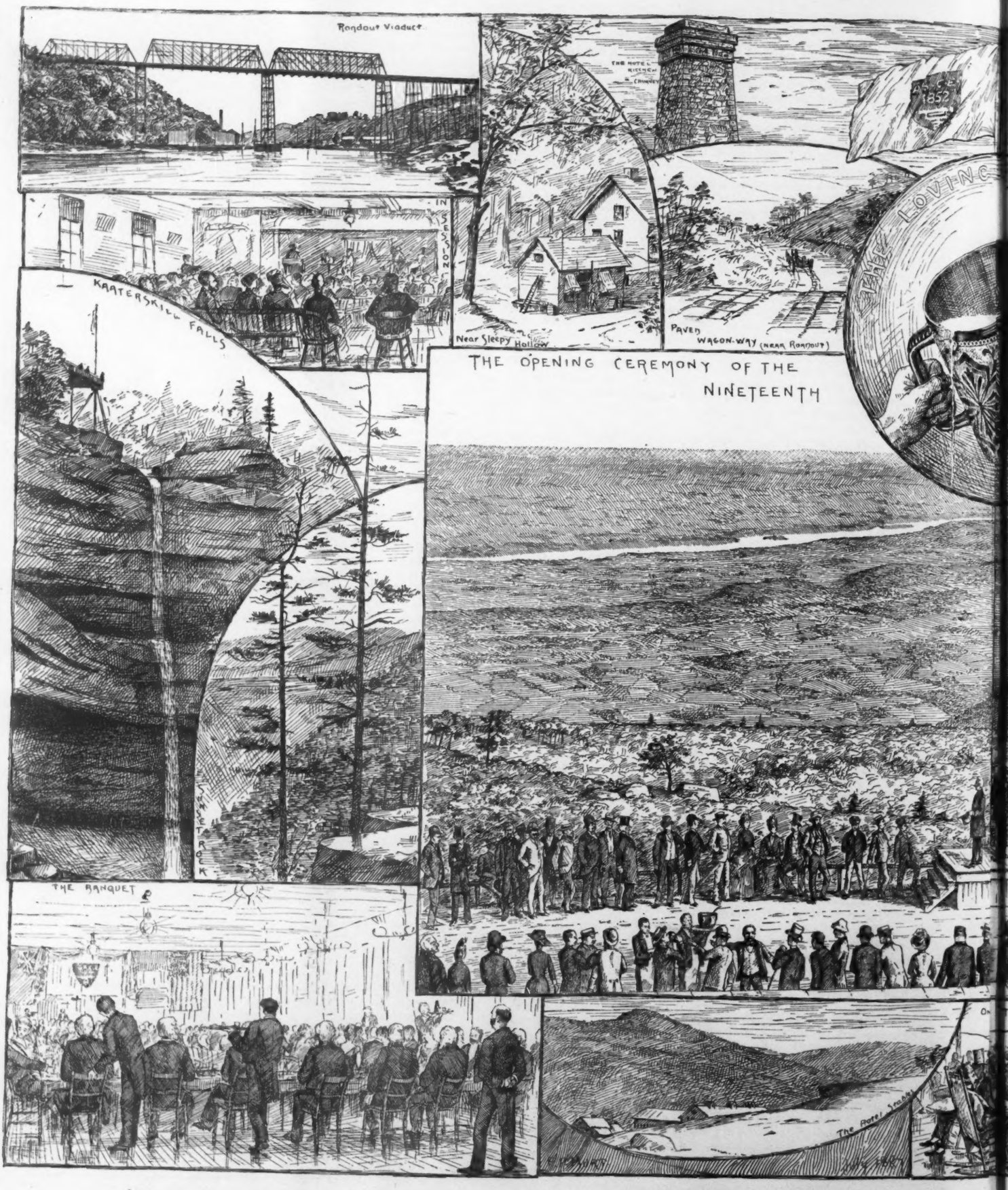
E. M. ECKERT	$100
J. J. R. CROES	100
STEVENSON TOWLE	100
THEODORE COOPER	100
Total raised at the Convention	$5,025

We presume the entire membership will be given an opportunity to add to this fund, and it is to be hoped that the response will be liberal, since there is no danger of raising too much. There is now a mortgage of $20,000 on the Society building (bought in 1881) over $10,000 having been raised by a previous subscription. Except for this mortgage, it would now be easily possible for the Society to purchase one of several desirable and larger buildings which are in the market. The present house is an ordinary dwelling of 25 ft. front. The proposed rear extension will give a meeting room about 24x60, at a cost of $5,000 or $6,000, all or nearly all of which will be so much added to the value of the property if sold to be turned into a store, as will be its natural fate; but even this building will probably be out grown in a few years, and there is a strong feeling among some of the members that it would be better to raise a little more money and purchase now a larger building which would serve for immediate necessities without material alternation, and admit of subsequent reconstruction on a more extensive scale at a later date, in much the same manner as is now proposed for the present building. As an example of what may be done, it is stated that there is a large 33 ft. residence on 29th st. between Broadway and Fifth avenue, which can now be purchased for some $10,000 or $15,000 more than the value of the present building. It is in a still more desirable location, and is still more likely to appreciate in value. There is much to be said for such a policy, and whether it is attempted or not will probably depend largely on the size of the present subscription, which was started by Mr. W. S. HAMILTON with the very generous sum of $1,000, and followed by President WORTHEN and ex-President WHITTEMORE with the generous additions of $500 each. If both ends of the subscription should be equally generous it would tend to put the Society in a position to avail itself of any opportunity which might suddenly arise even if a better building should not now be purchased.

Students of the Society.

Two steps were taken at the late Convention of the American Society of Civil Engineers which can hardly help to make it a memorable and important one. The first was the raising of nearly $5,000 within a few minutes, by voluntary subscriptions, to enlarge the Society's quarters, either by the extension of the present building or by the purchase of a new one. These quarters have been decidedly outgrown, and the larger and more commodious meeting room, which will now quite certainly be secured, can hardly help to have a beneficial effect on the attendance at the meetings. The second was a still more important and meaning step; a resolution of the convention by a vote of 35 to 11 that it was expedient to create a grade of "Students of the Society" similar to that which exists in the Institution of Civil Engineers, and the prompt appointment, by President WORTHEN, of a committee of five members who are to report at the October meeting of the Society, in time for any constitutional amendment which they may submit for that purpose to be acted on in the constitutional manner at the Annual Meeting in January.

The Committee appointed by the President consisted of ROBERT E. MCMATH and ROBERT MOORE, of St. Louis, FRED. BROOKS, of Boston, Prof. R. H. THURSTON, of Cornell and Col. WM. H. PAINE, of New York. But one possible criticism can be made of the Committee, that it is almost too one-sided in favor of the proposed plan. Were the proposition one on which there was likely to be any difference in opinion, this might be unfortunate, for four of the committee expressed themselves in favor of the plan at the convention, and the other, we cannot doubt, will be. But we risk little in saying that when the committee come to report there will be practically no difference of opinion in the Society as to the expediency of the mea-



THE NINETEENTH ANNUAL CONVENTION OF T
HELD AT HOTEL KAAT

N OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS,
EL KAATSKILL, JULY 1—8, 1887.

sure, and that all opposition to it, if any, will be confined to some minor detail. In fact, all opposition to the project which developed at the Convention among the 11 who voted against it was directed, not to the proposition itself, but to mistaken ideas of what was covered by it.

This was in a measure inevitable, for although the idea of some such grade was a familiar one to many members present, yet we are in a position to know that no one went to the Convention with any thought of bringing the matter forward at this time. It resulted entirely from an accidental discussion and conference of a few members over an after-dinner cigar on the day before the business meeting. It was then concluded that it would be a wise thing to bring up the matter at that meeting by a resolution designed solely to test the sense of the members present, with the idea that, if the general sentiment should be as decidedly favorable as was expected, and as it proved to be, a form for a constitutional amendment should be subsequently prepared and submitted. The appointment of a committee was an afterthought, resulting from a motion to appoint such a committee to report on the "expediency" of such a grade at the next Annual Meeting. This resolution, had it passed, would have made constitutional action impossible until a year from next January, but with the amendment that the committee was to report in October, it puts the matter in excellent shape for wise and deliberate action.

We cannot but feel, as we think all others will by the time the committee reports, that the creation of this grade will result in immense advantage to the Society. Of the effect of creating such a grade to the rising generation of engineers, and to the profession at large, fortunately, we have very direct evidence in the Institution of Civil Engineers, in which this grade was created nearly 20 years ago. The growth of that and other grades is given in the following table, showing the history of the Institution in brief:

MEMBERSHIP STATEMENT—INSTITUTION OF CIVIL ENGINEERS, LONDON.

	Honorary Members.	Members.	Associate Members.	Associates.	Students.	Increase.	Totals.
1837..	14	140	.....	98	.....	....	252
1842..	35	181	.....	241	68*	273	525
1850..	34	244	.....	371	32*	156	681
1860..	24	355	.....	537	14*	249	930
1870..	16	699	.....	988	173	948	1,876
1880..	18	1,209	1,287	568	613	1,819	3,695
Dec. 1883..	20	1,355	1,701	512	722	615	4,310
Mch. 1887..	20	1,568	1,375	484	949	986	5,296

*Until after 1860 Students were known as "Graduates," with somewhat different requirements.

It will be observed that the growth of the Institution in the past 3½ years has been nearly as great as the total membership of the American Society, and that the full members make less than 30 per cent. of the total, whereas in the American Society the full members are over 82 per cent.

It will also be observed that the period of rapid growth of the Institution (and no one will deny that it has been a healthy growth, purchased by no improper concessions for the mere sake of gaining numbers) dates from the creation of the grade of students. It would be an unwarranted assumption, which we have no thought of making, that it was, therefore, wholly or chiefly because of the creation of that grade, but it is probable that the two have a more intimate connection than may at first sight appear, for a reason which we shall see shortly, as also for the more general reason that it then, for the first time, became evident that the Institution existed, and was intended to exist, not alone for the benefit of those who were already at or near the top of the ladder, but for the benefit of the entire body of the profession, old and young. Certainly, the statistics of the Institution afford the strongest possible evidence that the creation of the grade was at least not harmful, and had no tendency to decrease the interest in the organization among the older men.

The idea of the grade of students, in brief, is simply this, that it shall be permitted to young men just entering the profession, or at the age of 18 years, to obtain a provisional connection with the Society on very easy terms and with very limited privileges, the only fixed ones being that they may receive the Society publications, and use the Society rooms and library, all further privileges being dependent on the will of the Board of Direction. So long as no inconvenience results they may attend the regular or ordinary meetings of the Society. When the grade becomes so large as to appear desirable, they may use the Society rooms on evenings fixed by the Board for special meetings of their own, as is now the custom in the Institution, where very lively and interesting students' meetings are held, attended by students only, and many excellent papers read which are often published in the Transactions.

This connection is terminable (1) at the pleasure of the Council, in case a young man's conduct does not do credit to the Institution, and (2) absolutely, on the student attaining the age of 26 years, it being the theory that by that time his standing should be sufficient to warrant his acquiring a permanent connection with the Institution in a higher grade, and bearing a juster proportion of the cost of carrying on the Institution, by paying a higher due. If he cannot or will not do this, his connection with it expires by limitation, without further action. The relative dues paid by the different grades of members are as follows:

		Inst. C. E.	Am. Soc. C. E.
Entrance	Member....	$31	$30
	Associate..	51	20
	Student....	none	

		Resident	Non-R	Res.	Non-R.
Annual	M.....	20.40	$15.30	$25	$15
	Assoc.	15.30	12.75 (Jr.)	15	10
	Stud..	10.20	7.65		

Students are elected by the Council (Board of Direction) on the nomination of any Member or Associate "under whom they are or have been engaged," and they are allowed under the constitution to attend the "Ordinary Meetings," although practically at the present time they hold special meetings of their own.

Right here we touch upon what may have been a special reason for the creation of the grade of students having an important influence on the growth of the Institution. The system of educating engineers in England is different from what it is in this country. In England students are articled to practicing engineers as "pupils" for a certain number of years, paying therefor a certain annual or other premium, and receiving little or no compensation for their services during that time, although much may be charged for their work by the engineer over them. The practical effect is, therefore, that only engineers connected with the Institution can nominate students, and as the privilege is a valuable one to students, and as the taking of students is profitable, and almost necessary to the practicing engineer, the latter is put at a great disadvantage if he is not connected with the Institution. It seems highly probable that this may have had a very considerable effect to increase the membership of the Institution, and to bring about the present condition of things, that it is practically impossible for an engineer to succeed in his profession unless he is connected with the Institution. This system was formerly quite common in this country. The writer of these lines, with many others, was brought up under it; but in the main, quite different methods of training engineers prevail here, and we think much better ones. Most of our older engineers became such by mere evolution and survival of the fittest. They began with the axe, chain, or rod; if they did well, they were given an instrument; if they still did well, they were given charge of a few miles of work; if they still did well, they obtained more work, and so on till they reached, if they could the top of the ladder. This system still prevails, and probably always will prevail to some extent in this country. We see no reason why it should not turn out, as we believe it does, as good or better engineers than the more formal and restricted English system. The other system of education, which is fast becoming almost universal, is in organized schools of engineering, which certainly does much more to ensure sound training than the English system.

These notorious differences of practice were brought up at the Convention as if they were new and unconsidered facts, which would tend to make a Student grade successful and desirable in England and unsuccessful and undesirable here. We can see no reason why they should have any such effect. The average American student, whether in the field or in the college, is certainly quite as much in earnest, quite as well behaved, and quite as amenable to discipline, as his English brother, nor is it easy to see where discipline can be necessary except in attendance at the meetings, where no difficulty from youthful obstreperousness has ever yet resulted, and the silent influence of example and the reserved power of prompt expulsion, would seem to be quite enough. On the other hand, the American student of any kind has the same need as his English brother of the advantage which may be derived from the study of the transactions, and otherwise. Whether in England or America, the advantages of an early connection of some kind with the Society are very great, both to the Student and the Society, and may be summarized thus:

To the Student: *First*, he obtains the Society publications, which contain the newest and freshest results of practice, at a price which he can afford and which places him under certain obligations to the Society, and at an age when he is most likely to read and profit by them. The more antiquated teachings of his text-books will thus be profitably supplemented, and he will obtain more rational and clear ideas of what engineering is in practice. His morale and *esprit du corps* will be stimulated, and he will obtain the foundations of a professional library in five to seven years of the Transactions which he could not otherwise obtain except at a much dearer rate, and would not be likely to obtain at all. That this would tend to improve the quality of the average young engineer cannot well be doubted.

Secondly. His name would be enrolled in the Society membership, and his chances for obtaining early and desirable employment greatly benefited. It is quite certain that Members would, in this country as in England, give a preference to such Students in filling vacancies, both from interest in the Society and from the more practical reason that the young man who did not choose to avail himself of such technical advantages was not likely to be so good a man—a conclusion which would be entirely justifiable, and nine times out of ten correct.

Thirdly. He would have as a right and not as a favor the privilege of having his papers published in the Transactions under the same rules as those of older members, of using the Society library, and until separate meetings of students were established or the Direction decided otherwise of attending the regular Society meetings. It does not follow that he should be asked to attend the informal collations which are provided by separate subscription in another room, after the meetings. Emphatically, he should not do so, but the invitation should be confined to the higher grades of membership.

Fourthly. The student would derive from his connection with the Society that nameless but material stimulus to good conduct which is recognized the world over under the general name *esprit du corps*; the silent influence of example; the feeling that the eyes of his professional superiors are on him, and that he must do credit and not discredit to the body to which he belongs. That this would have a material influence for good upon many a young man, both in respect to his personal and professional conduct, we cannot doubt.

On the other hand, what does the Society gain? It gains, first, what should be alone enough, that it is enabled to benefit many young men in the preceding ways at no cost to itself. But the Society gains far more than this, as thus:

First. It is made extremely probable that after a few years time, most of the more promising young men will connect themselves early with the Society and acquire an interest in it which will continue through life. They will then rise through the several grades as they advance in experience, instead of waiting, as nearly all do now, until they are qualified, or think they are, for the grade of full member, before they seek connection with it. The junior grades will thus be kept full, as in the Institution, and the requirements for full membership can be made somewhat more stringent, as they ought to be. This will be especially apt to be the case if an age limit of 30 years, or even 32 or 33 years, shall be added to the requirements for full membership. It will then be absolutely necessary that the student should pass from that grade to Junior and from Junior to Member, as he does in actual life, and occasional instances of hardship will be avoided, in which men who become "City Engineer" of some village or "Chief Engineer" of some few miles of line, have to be admitted to full membership, while much more experienced men holding less important nominal positions on more important works are unable to do so. The theory of the Convention is that no man shall become a full member until he is fitted for responsible charge of work in some one department of engineering. For the Board of Direction to attempt to pass upon that point directly, however, would be far too delicate a matter, so that the mere requirement that he shall have had for one year such responsible charge is substituted. There is however, work and work, and although the chances of life may throw a man early into "responsible charge" of some work, yet with very rare exceptions no man reaches the grade of qualifications contemplated by the Constitution who has not had such charge *and* reached the age of 30 years or more. Those rare exceptions will not be hurt, but rather honored, by having to wait a few years for their membership for lack of age, although otherwise qualified.

Secondly. The Society will reap a considerable pecuniary advantage, even although the dues barely cover cost of publication. The Institution of Civil Engineers charges Students $7.65 and $10.20, although the amount of matter published is for the present much greater than here. The American Society published last year 1,000 pages. Assuming that it will average 1,500 pages for the next few years ahead, the cost of its publications, on the basis of past experience, will stand about as follows:

Average cost of 1,200 to 1,500 copies of Transactions, 1,500 pp. each, including all expenses of engraving, composition, advance proofs, making up, printing, binding, mailing, postage, etc.	$8.50
Extra cost of printing any number of additional copies from the same plates and type, including only the cost of the extra paper, printing, binding, mailing, etc.	$3.00

In other words, the cost of the extra copies will be but little over one-third the cost of the first 1,200 or 1,500. If, therefore, the Student dues were fixed, say, at $6 and $10, although the student would not be fully paying for the bare average cost of what he received, and would thus be under a moral obligation to the Society which, we may be sure, many would appreciate, yet the Society would reap a profit of $3 and $7 each respectively, over the bare cost of what the Student received. If we allow, as we should, about $1 each for clerical and other expenses resulting from the grade, there would still be a very handsome margin left. If we remember, also, that these Students at about 25 become Juniors, and thereafter pay $15 and $10 each for 5 to 8 years, before they reach the present average age of becoming members, we shall see still more reason why the Society would be greatly benefited, pecuniary as well as otherwise.

We can take no more space for discussing this matter, nor do we believe it necessary to do so. It is well that there should be opposition to everything, for opposition ensures careful and deliberate action, but we have every confidence that the opposition to this measure, when it comes to be considered, will be confined solely to details, and that its all but unanimous adoption will result in great and material advantages to the Society and the profession of engineering. In one sense, the measure grants to students nothing definite but the privilege of "buying the Transactions for $6 a year;" in another, and a truer sense, it grants a great deal more.

The American Exhibition in London.

As erroneous reports have been printed in several newspapers respecting this exhibition, we are glad to be able, through a correspondent and representative who went over some weeks since, to give a true and uncolored description of the enterprise, which many believe is nothing more than the "Wild West Show." This is an error, for while the exhibition is not a "complete" sample of American products, yet at the same time many clever and interesting devices are shown, which are receiving very marked attention, and seem likely to satisfy their respective exhibitors, and make other manufacturers regret their not contributing.

The Exhibition proper covers a space 1260 ft. long by 200 ft. wide, and is laid out in blocks bounded by streets and avenues; on these blocks tasteful stalls have been erected, and instead of their being mostly vacant, as some reports have put forth, there is scarcely one unoccupied.

Many prominent firms of America are here represented. Among them are:

"The Waring Cables" or "Underground Electric System" of Pittsburgh, Pa., who have a large and interesting exhibit, showing every loop, joint and method of laying underground and aerial wires.

The Hall Duplex Steam Pump, of New York, in operation.

The Kilbourne & Jacobs Manufacturing Co., of Columbus, Ohio, with an exhibit of dray and wheel road scrapers, etc.

The Bush Interlocking Bolt Co., of Philadelphia, with an exhibit of their bolts as applied to American and English railways.

The United States Metallic Packing Co., of Philadelphia, and the Jerome Metallic Packing Co., of Chicago, both with large displays showing every form of packing applied to machinery.

A. Whitney & Sons, of Philadelphia, chilled cast-iron wheels.

Betteley & Wolf, of Philadelphia, railway appliances.

The Dougherty Railway Equipment Co., of Philadelphia, with their cable railways and railway appliances.

Chambers Bros & Co., of Philadelphia, with their brick making machinery in motion, making several thousand bricks daily.

The Chartier Gas Engine, of Sterling, Ills., in operation.

The Waterbury Rubber Co., of New York.

The Indurated Fibre Co., of New York.

The Ballard Repeating Arms Co., of Springfield, Mass.

The Gatling Gun Co., of Hartford, Conn.

Baugh & Sons, of Philadelphia, with a large display of animal bones and chemical fertilizers.

The International Terra Cotta Lumber Co., of Chicago, with a large display of fire-proof building material.

John Mathews & Co., of New York, with machinery for making soda water.

The Berlin Machine Works, with machinery for polishing timber, in operation.

Walter Wood, of Hoosick Falls, N. Y., with a large exhibit of reapers and harvesters.

The Johnson Harvester, of Batavia, N. Y.

The Gandz Belt, of Baltimore, by which all machinery in the building is run, besides the company having a large exhibit.

The ALSING new dry and wet pulverizer in operation.

FLEUSS' ice making machinery in operation.

J. B. STONER, of New York City, has several interesting exhibits to engineers, viz: A pneumatic grain elevator, of novel construction, automatic scales for weighing grain, capacity 4000 bushels per hour; automatic conveyor for carrying grain, coal, sand, etc., horizontally, an ordinary size, one being capable of conveying 30,000 bushels per hour any distance from 100 ft. to 10,000 ft. without any power. An automatic water meter capable of measuring water accurately and registering every gallon that passes through; an improved float for batteries, coaling stations, etc., and floating lighthouses, telegraph and life boat stations.

There are many other exhibits of equal merit, but the foregoing are the ones relating principally to engineering.

Adjoining the main building is the electric light station, the power for which is furnished by Hornsby engines. The power in the machinery department is furnished by a Wheelock engine. The whole place, including the grounds, is lighted by electricity on the Thomson-Houston system.

A switch-back railway and toboggin slide are in operation daily and largely patronized. The usual picture galleries and other amusements common to exhibitions do great credit to the enterprise.

Bartholdi's Statue of Liberty with diagrams of New York harbor is beautifully shown in a building by itself in the grounds. The States of Colorado, Kansas and Pennsylvania have large and handsome exhibits, and the Northern Pacific and Chicago & North Western Railways, show by their exhibits what the great West is capable of producing.

The total number of exhibitors is 500. The

highest number of visitors that have passed through the turnstiles in one day was 63,000. Average number daily 20,000.

In conclusion, from the above facts it seems reasonable to assume that the exhibitors as well as the owners of this enterprise, will benefit themselves by thus coming before the public.

Drainage of the Valley and City of Mexico.

Mr. EZRA D. SHREVE, Chief Engineer of the Bucyrus Construction Company, now engaged in the above works, sends us the following statement as to the proposed drainage of the city of Mexico in answer to our editorial "cautions" of July 2. As Mr. SHREVE has for a long time been studying the conditions of the problem from both an engineering and a commercial standpoint, we take pleasure in publishing the results of his investigations of a most interesting enterprise:—

It is now generally known that the work of constructing a considerable portion of the Grand canal for the drainage of the valley and city of Mexico, has been let to an American company, and scientific men, and civil engineers especially, have been advised by you to "keep a sharp eye out on the results of the contemplated improvement."

To such as may care to give this matter any thought or attention, a plain statement of the situation at this time, as observed in a careful study of the matter, on the grounds, during the past year, may prove to be interesting, and may assist any who are not fully posted, in grasping a true idea of the situation at the present time, and of the real objects which the improvement is intended to accomplish.

The valley of Mexico is a comparatively level area having a length of about forty miles from north to south, and a width of about twenty miles. This area is surrounded by a high mountain wall except on the northern boundary, which is made up of isolated peaks and ridges of volcanic detritus that connect the peaks in such manner as to make, with the mountain wall, a complete, unbroken rim around the entire valley. This rim, at the lowest part, is about 300 ft. higher than the central, or deepest part of the valley.

In order to relieve this basin, or the valley, from overflow by the mountain streams that descend into it, this rim was broken through by an open cut, known as the "Cut of Nochistongo," at a point near the north-western corner of the valley. This "cut through" is about 170 to 180 ft. deep at the highest part of the ridge, and serves to carry away the waters of several mountain streams that become great torrents in the rainy season, but it is not near deep enough to drain the lower part of the valley. This cut was made through a soft chalky material of volcanic origin, and known by the name of *tepetate*. It was excavated more than a century ago. The walls are quite steep, often perpendicular, for a considerable height. The Mexican Central Railway enters the valley through this famous cut; the roadway being notched in the slope on the east side.

About eight miles east of this "cut," the northern rim of the valley is now being bored through by a tunnel at a much lower level than the bottom of the "cut." This tunnel will be about six miles in length, and is constructed through *tepetate* also. At the mouth of the tunnel is a trench about two miles long, that debouches into a deep ravine. This trench is completed. The tunnel level is reached from the surface at intervals of about 1,500 ft., by means of shafts that vary in depth from about 100 to a little more than 300 ft. There are twenty-four of these shafts, of which many are already excavated to the tunnel level, and all are well under way. A considerable section of tunnel is now made. A good roadway and a trainway extend over the entire line of tunnel and greatly facilitate the movement of materials. The stations are also all connected by a telephone line at the head of the tunnel.

The "Grand Canal" ends with a depth of about 70 ft. The banks of the canal have slopes of one to one, or 45 degrees, and the bottom has a regular grade of 1 ft. per mile throughout. Both canal and tunnel are constructed in *tepetate*, and there is no rock or materials that cannot be excavated with a pick and shovel. The character of this *tepetate* is favorable in an extraordinary degree to the construction and maintenance of this drainage improvement. The average *tepetate* has about the same color and consistency as a bed of fire clay under a vein of coal. This same *tepetate* extends in a great layer over the entire valley, sometimes forming the surface and sometimes covered, to the depth of from one to ten feet, with soil or a blueish clay. So the city of Mexico has for a foundation these same materials, the *tepetate* forming the surface over considerable areas, and the blueish clay varying greatly in depth over other portions. Many streets and courts have been filled up from 1 to 3 ft. with soil and this blue clay, and as in northern cities, sometimes with filth, street scrapings, and like materials. There are many artesian wells in and about the city, and the construction of these wells has demonstrated pretty clearly the character of the formations underlying the city. The wells, with a few exceptions, penetrate through soil or blue mud to a depth of from 1 to 10 ft. then a layer of *tepetate* is penetrated, and next is a layer of this blue mud, then a thin layer of sand followed by a layer of gravel or small fragmentary stones of the size of gravel. The wells are now generally about 600 ft. deep, and they have penetrated three stratifications which are built up in the same order as that just given. These stratifications seem to mark epochs of volcanic disturbance.

Judging from a study of these formations, a volcanic eruption began with the ejectment of large stones and scoria which dropped near the base of activity. This was followed by a pretty heavy shower of small fragmentary stones about the size of river gravel, and following this, came a shower of sand of rather coarse quality, and after the sand came a heavy shower of very fine blueish mud, or at least it is now thoroughly wet and having the consistency of mud. Then the eruption went into decline with a long and heavy shower of fine white ashes, that is sometimes mixed with fine sand. This body of ashes brought down with it a considerable quantity of caustic lime and soda and a little potash, also some of the carbonates of these elements, and a small per cent. of the chlorides of lime and soda. In composition, it seems to be the comparatively non-volatile elements in the granitic, syenitic, and porphyritic rocks, and aluminum is greatly in excess of other elements. The storm waters have leached the soluble caustic matters and the carbonates out of the *tepetate* on the higher levels and it has been carried into lake Texcoco and there deposited on the bottom of the lake by evaporation. In this way the waters of the lake have become so saturated with caustics that neither animal nor vegetable life can exist therein. And this lake is the receptacle of all the filth and sewage that floats out of the city. Here, then, is a lake having an average area of 105 sq. miles, and the waters strongly charged with caustic soda, and in this lake the sewage of the city is absorbed and changed so that there is no odor of sewage noticeable even near the inlet where the sewage is discharged. This lake is five miles directly east of the city, and an open channel conducts the sewage from the city to the lake. The cross-section of this stream is nearly 100 sq. ft. and the current is about two miles per hour, and more at times. The historian has implanted a strong belief that the city is built on an island, and this may have been the case with the original Aztec city. But, even in the days of the Aztec kings, the waters were confined by numerous dikes to certain sections of the valley, and it is certain that if the dikes were broken, the central part of the city would soon be on an island, and a large part of the modern city would be submerged. So, it cannot be said that the city has risen above the waters which surrounded it in the days of Cortez, nor that the waters have "receded." On the contrary, by the constant filling, in the bottom of lake Texcoco, the waters are actually *rising* into the city, coming up higher every year.

Indeed, it is this inroad of the waters upon the city that is causing the government to rise up and do something to relieve the city from the threatening danger. With the citizens of Mexico City, it is now a case of "sink or swim." That is, they can sink the canal for drainage, or swim out. That is just their dilemma, and they have chosen to pay their money and have the canal, rather than "to go a swimming."

Since the city is in the Federal District, the same as Washington City, the authority having the matter in charge is the Federal Government. The Congress has authorized the construction of the drainage works, and has provided a constant revenue to defray the expense. President DIAZ has placed the execution of the works in the hands of a commission.

That commission is composed of five good business men, whose real estate interests in the city would be inducement enough, if there were no other reasons, to have the works speedily constructed. The rising waters are injuring many good properties through the absorption of water in the walls of the lower stories, and not a few walls are settling into bad shape. The drawing of this water to a lower level cannot harm buildings very seriously, except where the underlying *tepetate* is many feet below the surface. It is a mistaken notion that the city is built on a muck swamp, or a quagmire. It is at most but a few feet below the surface to solid material that will not be affected by draining the water away. However, the completion of this drainage work may cause some increase in the death rate for a year or two, and some few buildings may be somewhat seriously affected about the foundation. But the city, as a whole, will not be seriously disturbed by lowering the water level a few feet. The construction of the canal and tunnel will result in the lowering of the water level but it will not abate the sewer nuisance now in existence. The reconstruction of the sewer system is necessary to accomplish the thorough sanitation of the city.

The tunnel and grand canal are intended to serve as an outlet for the sewer system of the city, and to drain the valleys of surface water as well. The tunnel work is now progressing under the immediate direction of the commission, The contract just awarded to the Bucyrus Construction Co., is for the excavation of the canal to the depth of about 25 ft. The Bucyrus Foundry & Manufacturing Co., Bucyrus, O., is placing two large dredges, carrying a boom 70 ft. long, on the works at once. These machines will be ready for work about the 1st of October. The work will be pushed when the machines are once on the ground, and both the General Government, through the President, and the City Council will exert their influence to have the whole improvement completed at the earliest possible moment, for the work is one of absolute necessity to the preservation of the city.

Nineteenth Annual Convention of the American Society of Civil Engineers.

(*Continued from page 29*).

SATURDAY, JULY 2.

Mr. THOS. C. CLARKE, of the Union Bridge Co., was elected Chairman, in accordance with the custom of choosing a chairman from among the more eminent members residing near the place of the convention. The day was very hot, and a brief adjournment to partake of "the compliments of the Committee", in the form of claret punch, was a welcome interruption to the forenoon's proceedings, which were entirely devoted to the discussions of the list of questions sent out to the members, as printed in ENGINEERING NEWS of July 2, chiefly relating to bridges. Ex-Presidents ADAMS, MCALPINE, WHITTEMORE, GREENE and GRAFF with President WORTHEN were pilloried on the stage behind the chair during the first part of the proceedings, and carefully shut off from draught by the scenery. As the temperature was in the neighborhood of 90°, however, they were shortly relieved from this unenviably dignified position and allowed to mingle with their fellow mortals on the floor, where a cooling breeze relieved the heat. The following written discussions were first presented:

Mr. JOHN A. WILSON presented his ideas as to a proper system of bridge inspection at some length, pointing out the evils of the present lack of system and of simply ordering "good" bridges. He thought it difficult to establish an absolute standard of rolling load. Each road should fix one for itself. There was a steady tendency to increase. It would certainly be well to decide on a standard form of bridge floor. He was not prepared to speak as to buckle-plate floor. It was very desirable to use a Latimer or other safety guard. He summarized at some length his objections

to railroad grade crossings, and thought that either over crossings or interlocking switches and signals, should be used everywhere. Properly drawn legislation he considered very desirable.

Mr. WILLARD S. POPE replied at considerable length as to governmental supervision of bridges. Self-interest was not a sufficient safe-guard. A Commission organized by the State should be established with large powers of inspection and condemnation; but this should not relieve the owners of the bridge from full responsibility. The Commission should be headed by an experienced bridge engineer, who should receive $10,000 per annum, term of office 5 years. The total cost for a State would be about $40,000, half paid by the State and half by the companies. Appointments should be made by those who have bridges to build and care for, preferably by railway managers.

Mr. A. BEYSON thought inspection once a year by competent men should be compulsory. Short riveted trusses should have a member removed and tested every 5 to 10 years, depending on traffic; longer bridges, under 150 ft., every 8 to 12 years. There should be more than one standard rolling load, to conform to different traffics. If width and strength of floors were specified, the further details might be left to designers. Guard timbers should be prescribed, high for southern roads, low for northern, on account of snow ploughs, which are about 13 ft. wide. An iron guard railing, high enough to bear against the body of the car and wide enough to pass snow ploughs, should be used in addition to the track guards. Greased timber wales might be attached to this guard-railing and some spring action provided similar to ferry-slip guard piling. These latter suggestions were received with some amusement.

He favored the closing of small openings by solid floors and ballast, but was not prepared to specify a limit of span. As to Latimer safety-guard and interlocking apparatus, he said YES in capital letters. Legislation seemed the surest way of insuring good practice in these matters, and he favored a series of suggestions which would be likely to be embodied in legislation. Bridge inspections were made in quite too perfunctory a manner; and engineers would be helped to proper decision in their reports by wise legislation.

Mr. E. S. PHILBRICK thought that railroads should be required by law to file plans of all their structures; and that annual inspections should be made. He was not clear that the same standard load should be applied indiscriminately to all lines. For all trunk lines a standard rolling load could and should be adopted. There should be several standard bridge floors. Buckle-plate floors and ballast gave a smoother motion and greater security in case of derailment, but were open to the serious defect of concealed rust, and he did not approve of them for that reason. There should be a Latimer or other safety-guard for all openings over 10 ft. wide. Grade crossings should never be allowed. Legislation is desirable, which does not relieve the companies of due responsibility. *Publicity* is the most effective weapon of reform.

Mr. E. P. DAWLEY, (N. Y. Prov. & B. R. R.) thought it would be a very valuable contribution toward the welfare of the public, and a great aid to engineers of maintenance of way, if our Society would make some recommendations as to the questions submitted, and as to proper rules for maintenance. It would be likely to result in higher standards of practice. It was pretty well agreed among engineers that 3,000 lbs. per ft. was not a sufficiently heavy load to properly provide for the future. His company had used for many years a rolling load of 128,000 lbs. on 5 axles, 19 ft. 7 in. wheel-base, followed by 3,000 lbs. per lin. ft. of train, with 500 lbs. for floor. He saw no great benefit in a uniform floor. For double track he used hard pine ties 8 in. x 9 in. x 26 ft., laid flatwise, 15 in. between centers. The tracks were 13 ft. center to center, and had three 8 x 9 guard timbers, flared at ends of bridge; guard-rails in each track running to a point in the center, all as per Latimer-Childs safety-guard. Was not yet worked up to buckle-plate floors, as it increases height and difficulty of inspection. Did not know much of re-railing frogs, but believed in running rails to a point. The overhead crossing was far better than interlocking, but one or the other should be used and strictly enforced by law. In a few years our largest ideas of what is required will seem meagre and illiberal.

Mr. A. LUCIUS thought the companies should be held strictly responsible for all failures. The specification of stresses and of rolling load must be considered together. The Erie specifications he thought sufficient if the uniform load stated was preceded by a heavy Consolidation and that by a yard engine with 48 tons on a 12 ft. wheel base. Certain standard details of a bridge floor might well be recommended. He would prefer iron ties on iron stringers to a buckle-plate floor ballasted, because of the trouble that moisture and want of inspection might cause with the latter. The Latimer safety-guard should be used on all bridges. All bridge floors should be of the same width as embankments. Grade crossings should be restricted. The report of a large committee selected to consider the questions suggested, would, he believed, be very advantageous; but they should not enter too much into detail.

Mr. C. A. MARSHALL, of Johnstown, Pa., believed that the controlling legislation should be national. There should be a commission of engineers and experts appointed to license inspectors in three grades, (1) materials, (2) fabrication, (3) design. There should be stated fees for inspection. Builders to furnish the inspector a complete copy of strain sheets and detail drawings. The inspection of completed structures should be left to the State. The question of rolling load was overshadowed by that of impact and its effect. The floor systems should be designed for heavier loads than now, and that would be a proper subject for recommendation by committee but not yet for legislative action. A standard minimum weight of floor would be a good thing for all bridges under 150 ft. Those over 75 ft. need not be as heavy as buckle-plate and ballast; below 75 ft. should be as heavy. Both inside and outside guards should be required by law, and also a standard opening between ties, say 4 or 5 ins. A National Commission would be very desirable, and to bring about its existence and influence corporations in the right direction is a proper task for this Society.

Mr. J. G. DAGRON suggested the appointment of a committee to investigate the subjects submitted thoroughly and to report say at the next annual meeting or convention.

Mr. J. M. GOODWIN thought that while any inspection had a value, most of them had but a small one. The Ashtabula bridge was inspected periodically from the date of its erection to its collapse, and the inspector was thorough; he went over everything. The trouble was, he had not proper knowledge, and looked with unappreciating eyes at the gravest dangers. Every bridge should be floored so that a locomotive off the track would pass safely over it. With high and strong outside guard rails, flaring at the ends, the suggested continuous coat of ballast will be unnecessary.

The Latimer re-railing safety-guard had, in several notable instances of record, saved trains and bridges from wreck. This very effective appliance for replacing derailed wheels on the track, should be set in each approach to every bridge. Interlocking apparatus or overhead crossings should be universal. Legislation has, as a rule, worked more harm than good. He thought it was not calculated to effect much. The Society would do well to cause the appointment of a committee of its members to prepare a set of resolutions intended to serve as a presentation of the verdict of the Society on the questions submitted. These resolutions to be submitted to members for discussion; the resolutions to be then revised, and submitted to letter-ballot.

The preceding closed the written discussion, although such discussions were received later from Mr. G. LINDENTHAL and others.

Ex-President WHITTEMORE began the oral discussion by an address of some length, which was listened to with great interest and loudly applauded. He had been greatly interested in listening to the papers, and hoped the whole matter would have thorough discussion. His connection with his present road (C. M. & St. P.) had begun 22 years ago. They then operated 273 miles. Since then they had built 2,700 miles and purchased 2,500, and it might well be believed that to keep track of all this work had kept the engineer busy. When they started in they had prepared a set of standards, and they had been very much gratified with the result—for about a year. Then they began to have to alter them, and revise; and the process had been going on ever since. On their 5,400 miles of road they had 110 miles of bridges and trestles; and in the same ratio there would be nearly 2,800 miles of such structures in this country. Of their 500 bridge spans of some size, about 50 were iron and the rest wood. They had some 12,000 culverts, designated by odd numbers, bridges and trestles having even numbers. They had a plan of every structure and each was inspected twice a year. They had a book account against each structure and could tell precisely the history of each. They had been somewhat amused by a recent demand of Commissioners for copies of all their reports of inspections. They would have made many wagon loads, and were not furnished. As a consequence of their system he was happy to report that in the past 22 years they had not had a failure of a single structure under normal conditions of service. They had come pretty near to them, but they had never had one. This statement was loudly applauded, as also an addendum that, "if there is any class of persons we do love, it is the average railroad commissioner."

Mr. THEODORE COOPER first carefully "wet his whistle," and then stated that the C. M. & St. P. was evidently in good hands. The usual trouble was that no one owned the roads and the inspection of bridges was mechanical. Nevertheless it was a fact that there were next to no failures of bridges—he thought none—chargeable to bad material. They were chargeable to accidents or bad design. Examination of plans was not of much use, for the plans did not correspond with the structures. Nor were the teachings of inspection appreciated. He had known people to wonder why rivets gave out every three months, and simply keep on putting new ones in indefinitely. He thought inspectors should be older men in experience at least, and did not believe in legislation. The owners and officers of roads should be held criminally responsible. As for recommendations of any kind by the Society, through committee or otherwise, he did not believe in them. There were twenty professions represented in it, and not five per cent. of the members had an experience which the expert bridge men would consider qualified them to pass on the questions submitted.

Mr. H. STANLEY GOODWIN deprecated legislative interference, but the condition of highway bridges, especially, of which there were ten times as many as railroad bridges, demanded attention. The rolling loads were increasing very fast. He thought a standard bridge floor hardly practicable, but believed in requiring overhead crossings wherever possible.

Mr. A. M. WELLINGTON regretted to see so strong a tendency in the written discussions to run toward elaborate legislative or other machinery to insure safety, instead of resorting to the simpler, safer and cheaper plan of building bridges strong enough in the first place to be beyond the need of such incessant watchfulness. So far, the tendency of bridge building had been to provide only for the necessities of the present, and as a consequence there had been a continuous renewal of structures going on for the past ten years, and more to-day than ever, because they were too weak. The same would be the case with the structures which were going up to-day. It was quite certain that rolling loads were to continue to increase in the future. The effect of the introduction of automatic brakes and couplers would be very great to increase train-load and engine weights, and also speed. He was not prepared at this moment to attempt any careful discussion of the questions submitted, but considered that great good might be done by their discussion in the Society and the formulation through committee or otherwise of some recommendations. The work needed doing, to avoid unwise legislative action if nothing else, and there was no other possible body for doing it but this Society.

Mr. PERCIVAL ROBERTS, Jr., made some amusing and interesting remarks on the difficulties of inspection and inspectors. They came around with their little tack-hammers and often made no end of unreasonable trouble in the shop. Mr. WHITTEMORE reinforced these remarks, stating that they had often been regularly swindled in inspectors. Some of them would pass their time reading dime novels, until they were called out to inspect some car-load and then went back to their novel.

Mr. C. C. SCHNEIDER followed in a somewhat similar view, commenting on the carelessness shown in selecting inspectors. The practical effect was that the good man had to take a back seat. Mr. MCCOMB presented in the same connection the recently passed Massachusetts law, the more important provisions of which have been already given in these columns. Much laughter was occasioned by a clause in the law which states that "the specifications, *if any*" shall be submitted with plans, etc.

Mr. FREDERICK GRAFF brought up the threatened invasion of Philadelphia by elevated railways, and asked what inspections were required to make them safe. Chief Engineer SLOAN, of the Manhattan Elevated, answered. They had a full corps of inspectors and received at 10 A. M. every day a report of every defect discovered in the structure. They had also night inspectors. Engineer LUCIUS, with two assistants, had also been engaged for four months making a careful technical inspection of the whole structure. The Sixth Ave. line was proportioned for 15 and 21 ton engines, the Second Ave. for 30 tons, and the Third are for 15 tons, but they had strengthened the latter, and were now using 19 and 21¼ ton engines on it. Rails on their sharp curves lasted 18 mos. They used 8 x 8 ties, 20 in. centers, and were replacing their 50 lb. rails by 70 lbs.

They had tried all forms of angle bar splices with very poor results, but had recently begun putting in the Fisher joint (the first, about two years since), and it was rendering most excellent satisfaction. (In subsequent conversation Mr. SLOAN stated that they were now putting in the Fisher joint on all new work and much of their old, and expected to use it exclusively hereafter.) He did not consider that beveling the joints did any good. They had done that with their first Fisher joints, but did it no more. The gain in smoothness was wholly from the joint. The Chatham Square crossing had now been passed by 4,000,000 trains, and they had only had one collision, which he regarded as a great tribute to the efficiency of interlocking. In that one case the engineman carelessly ran by a signal, and afterwards insisted it was white.

Mr. THEODORE COOPER called attention to the error in widely published statements of Mr. BENJ. BAKER that the elevated roads were giving out from vibration. Wherever he got his information, it was not so.

The Convention then adjourned for dinner. We postpone till next week the conclusion of our report of the technical proceedings in order to include herein a report of the business meeting held on the evening of Wednesday, July 6.

THE BUSINESS MEETING.

President WORTHEN presided, and some 46 members only were present, many having left before the meeting and many others having preferred the charms of the piazza. As was natural under such circumstances, those members who were present included an unusually large proportion of those who take a great interest and active part in the Society.

The reading of the minutes of the last meeting being suspended (fortunately, for they were in New York) and tellers appointed to canvas the pending ballot on their return to New York, reports of committees were called for. The Committee on Standard Time had no report to make, the chairman being abroad, but asked to be continued. The Committee on a Joint Engineering Library had no report to make, but were continued. The Committee on the Proper Relation to Each Other of the Form of Rails and Wheels reported progress "and a great deal of progress." They had gathered together a great deal of statistical and other information bearing upon the question of the form of rails and wheels, much of which had never been collected before, and was of striking interest. They might easily have made a quite voluminous progress report and had hoped to be able to present a final report at this Convention, but the time being too short for the latter, it had appeared preferable to make no report whatever until they could present all their matter together with their final conclusions. Two facts of great interest appeared to be established from their investigations, that sharp flange wheels made the largest mileage of any class, even those which failed from "old age" only, or continuous wear in the tread, and that the wear of outside rails on curves was at a much slower rate while the rail corner was new and the radius small, and increased as it wore to the form of the flange-fillet. They hoped to have a final report ready in a few months and asked to be continued, which was granted. The Committee on the Compressive Strength of Cement, which made a progress report in the Convention meetings and was doing a good deal of work, was also continued.

The appointme t of a nominating committee was then taken up. Mr. Jos. P. DAVIS stated that the method of nominating by sections had heretofore been somewhat loose, and he saw in the last ENGINEERING NEWS, a map, showing the distribution of the membership by which a more just apportionment could be made. Counting roughly from that map, he found the distribution was about as follows:

1. Resident, within 50 miles of New York	200
2. New York State, New England and Canada	207
3. New Jersey, Penns., Ohio, Ind, Mich., etc	153
4. Illinois, Mo., Wis., Minn., etc	150
5. Southern States and Mexico	144

He suggested that these groups be followed, and that the members from each nominate one member of the Nominating Committee. This was on motion agreed to, as also a motion of Mr. WHITTEMORE, that the chairman of the committee, as last year, be an ex-officer and resident member.

The members from each group then flocked together in separate corners and in the center of the room to select nominees. The flocking together of the representatives of the last group, only one of which (Mr. MENDES COHEN) was present, created much merriment. The following were nominated and elected

1. Col. WM. H. PAINE, Chairman.
2. CLEMENS HERSCHELL.
3. FREDERICK GRAFF.
4. ROBERT E. MCMATH.
5. CHARLES H. LATROBE.

A nomination by the ladies present of Mr. MENDES COHEN was voted informal.

New business being then in order Mr. ROBT. E. MCMATH made the following motion.

RESOLVED, that it is the sense of this meeting that it is expedient to create a grade of STUDENTS OF THE SOCIETY, said grade to consist of young men over 18 and under 25 years of age who are engaged in the study or practice of Engineering. Connection with the Society to cease as each individual student reaches the age of 25, unless he shall be previously elected to a higher grade.

Mr. MCMATH thought that the advantages of such action would be apparent on reflection to every member of the Society. It extended a helping hand to young men and interested them early in the Society, while at the same time it gave them merely a temporary connection with it, enduring only through good behavior or until the age of 25, when their connection with the Society would cease if they had not been in the mean time elected to a higher grade. For a small due of $5 to $10 (the latter for resident students) they would obtain the transactions of the Society and such other privileges as might be voted them, and the creation of the grade would tend powerfully to correct an evil which was generally felt, that men did not begin to think of joining the Society until they were of age for full membership, leaving the lower grades comparatively weak. The proposed grade was modelled precisely on that existing in the Institution of Civil Engineers, where it now numbered 957, and was universally felt to be a very valuable feature of the organization. The students there did not attend the regular meetings, but held special ones of their own which were well attended and conducted and brought out many valuable papers. It was needless to say that the creation of such a grade did not mean the lowering of the requirements of the higher grades, but rather a substantial addition to them; and so long as members were obtained only from healthy and proper material he thought there was no feeling in the Society opposed to an increase, especially in the junior grades, but rather decidedly in its favor. Young men needed some such formal connection with the great body of their profession, both for the direct knowledge they would gain from the Transactions and from the stimulus which it would give to them professionly. The Society also needed the interest and good will of all engineers, of all grades of experience, if not purchased by improper concessions. Mr. MCMATH'S remarks were loudly applauded.

Ex President DON J. WHITTEMORE in rising to second the motion, said that if he felt that he could say anything that would add to the emphasis of Mr. MCMATH'S remarks he would do so, but it only seemed necessary for him to second Mr. MCMATH'S motion.

Mr. THEODORE COOPER rose at once and opposed the resolution. A nursery was a necessity in every well regulated family, but it required attachments which this Society did not possess. Such propositions affected him much as a red rag did a bull. It was easy to detect in them merely another formulation of plans which had not met acceptance, the true meaning of all of which was merely—*let down the bars,—remove our requirements,—obtain members at any cost,—dilute ourselves* with improper material. He appealed to the good sense of the Society as to what would be the consequence of admitting a hundred boys of 18 to our meetings; we should have a perfect pandemonium! What would be the moral effect on their unformed characters of the unlimited punch-bowl after the meetings, which can be placed before the older men without harm? He thought it an entirely improper suggestion. Those who favored it appealed to English experience but they did not appear to consider that the conditions were entirely different. The English students were the pupils of members and under their control. We had nothing like that in this country, but there was nothing to prevent the boys overrunning us. What would be the effect of crowding out annual conventions with a lot of boys just out of school? He had no desire to see babies in our Society. It was time enough to admit them when they had arrived at years of discretion.

Mr. A. M. WELLINGTON thought Mr. COOPER had made an appropriate simile in stating that the proposition affected him as a red rag did a bull, as those members would appreciate who had ever been at a bull-fight and seen what an unreasoning and irrational animal a bull became in the presence of a red rag; how they would dash themselves violently against imaginary enemies and leave at one side the real point at issue. As he understood the resolution, Mr. COOPER had wholly misapprehended the real nature of the proposition. It did not give to the students any fixed rights whatever, except to receive the Transactions, use the Society rooms and library, have their names enrolled in the Society lists, and when their numbers should increase sufficiently, to hold special meetings of their own in the Society rooms. They would have no right whatever to attend the Conventions or Annual Meetings, or even the ordinary semi-monthly meetings, although the students in neighboring colleges now had a standing invitation to do so. Neither was it any sense implied, even if they attended the latter, that they should be invited to attend the informal collations after the meetings, provided by special subscription of members. The invitations to them should rather be expressly restricted to Members and Associates. He shou'd certainly oppose the resolution as strongly as anyone if these things were proposed or likely to result, but they were not. The full privileges of the Society should only come with age, but those which it was proposed to grant were quite enough to make it greatly to the advantage of young men to join, while in no way encroaching on the privileges of members, and certainly not tending to lower the requirements for full membership, but rather the contrary, as it was desirable they should. The attractiveness of the lower grades should be increased for there was too great pressure to become members before really qualified, and to accept that grade only.

Mr. JOS. P. DAVIS, who subsequently voted against the resolution, submitted a motion to refer the matter to a committee of five to report at the next annual meeting, the effect of which would have been to postpone all possibility of action in the matter for a year and a half. The motion was ruled out of order.

Mr. COOPER said that if the statements just made were correct all this proposition amounted to when boiled down, was to sell our Transactions to young men for $5 per year. In that case he was quite willing it should be done, but he was opposed to all these loose, disorganizing efforts. We had already our grade of Junior, which was practically much the same thing as the proposed grade of Student, and he saw no need for it.

Mr. OBERLIN SMITH said that so far as he understood the proposition it could do us no harm while it would certainly do the young men good. He was heartily in favor of the proposition which seemed calculated to do much good, unless there were objections not yet brought forward.

Prof. R. H. THURSTON created much merriment by some good-natured remarks as to the changes which had taken place among students, "in the last fifty years," or even (on Mr. COOPER'S protest) the last 15 or 20 years, since Mr. COOPER was a student. There was now a severe thinning out process, and students were a better and soberer class than then. They were nearly all of them in earnest, and there need be no fear of their doing discredit to the Society by improper behavior, while much technical work of a very high grade, which would honor our Transactions, as Mr. WELLINGTON had stated, was done by students and very young men. Speaking for the students who had been under him at Cornell and elsewhere he felt sure that a very large proportion of them, and those chiefly of the better class, would feel honored and gratified by being afforded an opportunity for a connection of any kind with this Society, would gladly avail themselves of it and be stimulated and benefitted thereby, and would be not at all likely to discredit the Society in any way. He heartily approved of the proposed grade.

Mr. MCMATH stated that a movement was on foot in the St. Louis Club to have the students attend the meeting, and he thought for his part there would be no objection to have the students invited to attend all our ordinary meetings, although it might not be desirable to give them any such constitutional right.

Mr. ROBERT MOORE said he could see no reason for hesitating about the matter on account of danger to the Society. The connection of the students as such was terminable at the pleasure of the Board of Direction or at a fixed age at 26, and it did not affect the admission to the higher grades in any way. He thought the movement might do much good and could do no harm.

After a brief pause for any further remarks, which were not forthcoming, Mr. MCMATH suggested that in view of the importance of the question the vote should be a rising one, which was done, with the result of

Ayes	34
Nos	11
Total	45

The majority in favor was thus more than 3 to 1, the negative vote also including a number who stated that they merely voted against the proposition provisionally from lack of investigation.

Ex-President GEO. S. GREENE then re-presented Mr. DAVIS' motion to refer the matter to a committee to report at the Annual Meeting. An amendment was at once proposed, and accepted by Gen. GREENE, to have the Committee report at the October meeting, in time to have constitutional action which they might recommend acted on at the next annual meeting, and as thus amended the resolution passed without opposition. The next day the President announced that he had appointed the following committee:

ROBERT E. MCMATH, St. Louis.
ROBERT MOORE, St. Louis.
FREDERICK BROOKS, Boston.
Prof. R. H. THURSTON, Cornell University.
Col. WM. H. PAINE, New York.

All of the Committee but the last were present at the meeting, and voted in favor of the resolution.

TECHNICAL EDUCATION.

Mr. OBERLIN SMITH then offered the following resolution, supplementing it with a few remarks:

Resolved: That the Board of Direction of the Society be requested to consider the advisability of appointing a Committee on Technical Education and Professional Training, which shall annually report to the Society the status and progress of such instruction in the United States and Europe, together with such data, statistics and suggestions relative to the subject as may seem to them proper; said Committee to cooperate with similar committees of other engineering societies, should such be formed.

Mr. EDWARD P. NORTH offered the following additional resolution:

Resolved: That if created by the Board of Direction, such Committee be desired to give especial attention to the matter of the formation and administration of those institutions known as the "Land Grant Colleges" established by the several States under the "Morrill bill" of 1862, and report to what extent said colleges are carrying out the original "leading objects" prescribed by that Act of Congress; to what extent the funds devoted under that law have been applied to such objects, and to what extent, if at all, diverted from their original purpose, and further, to report in what manner said funds may be, in the future, in the opinion of the committee, rendered most useful in the promotion of the industrial arts, and education of the industrial classes.

Mr. COHEN thought the resolution referred to matters foreign to the purposes of our Society, and he feared it would get us into trouble to attempt any such action.

Mr. OBERLIN SMITH thought that there need be no fears in in this respect. The Committee were not obliged to say or do more than they chose, but men existed in the Society who would take an interest in such work and devote a good deal of time and thought to it, and their suggestions and criticisms so far as they want would be likely to be helpful and valuable. It was all a question of the organization of the committee but the general idea that practical engineers should assist by informal council in the wise conduct of technical education seemed a good one.

Mr. COOPER remarked ironically that the resolution certainly seemed the only logical outcome of action just had. Having voted to take children into our society the next step naturally followed, that we should understand how to manage the nurseries in which they were brought up. He raised the constitutional point that such a committee was not within the purposes of the Society as defined in the Constitution.

On reading the clause however this appeared not to be the case, and Mr. ED. P. NORTH stated that the Society need not quarrel with the conclusion drawn by Mr. COOPER. He considered that there could be no better way to aid in the advancement of engineering than to aid in any legetimate way the sound education of the rising generation of engineers. The suggestion that a committee should report annually on the progress of technical education and professional training was a proper and sound one, and might if acted on do much good.

Prof. R. H. THURSTON then made a very able and eloquent address, pointing out the advantages of which might come from such action, which we regret it is impossible for us to take space this week to report properly. He stated that the men who were shut up in their closet, conducting educational institutions, felt the need of some organized counsel from the men engaged, or who had been engaged, in practical work. The counsel might be ever so informal and fragmentary but it could not help being of assistance in keeping such institutions from unconsciously growing wrong. This was especially true of those institutions which, through land-grants or otherwise, had come in possession of large funds which were daily growing largely. In evidence of what a committee could do, he instanced what one man had done.

Dr. WOODWARD, whose report on Technical Education, although he was not an engineer, was a masterpiece, and had led the Baltimore & Ohio Railroad to take a step which could not but have a most important consequence, appropriate $20,000 annually for technical education on their line.

After some further discussion as to how such a committee could be organized the first resolution passed by a vote of 25 to 9. The hour was now late and the members tired, and in putting the second resolution the vote became sadly mixed, between amendments and otherwise, and at last it was suggested and voted to lay it on the table. After some further business of no especial interest or importance, the business meeting adjourned.

An adjourned meeting was held on July 13, at which the current ballot was canvassed and the following fund elected. The question of the house improvements was also discussed. The total subscription to date was reported as $5,225, and it was stated that the Board of Direction had concluded to send out a letter to all connected with the Society, stating the sum raised and requesting further subscriptions that the Board might be able to choose between enlarging the present building and buying a new and more commodious one, but in the mean time to take the necessary formal steps for proceeding early with the enlargement of the present building.

ANNUAL ADDRESS OF MR. WM. E. WORTHEN, PRESIDENT OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

(By an oversight the portion of this address published last week was not marked "to be continued," though the balance of copy was not then at hand.—ED. ENG. NEWS).

Concluded from page 29.

BRIDGES.

The first Howe Truss was built across the Connecticut river at Springfield, Mass., in 1840. It was a wooden bridge with double intersections. Smaller bridges had been built in the same line of road, but this was a very important bridge at the time. HOWE was a carpenter and the bridge was designed by average judgment, and the construction of one bridge made the precedent for another. Engineering science was not then applied to the calculating of stresses. Undue confidence in the form of truss, and the successful construction of many bridges in wood led to the Ashtabula accident. The strong desire for the construction of iron bridges at minimum cost, and the high price of iron, led to the construction of weak designs of this material and postponed its adoption for many years. With the reduction of the price of iron, and a better understanding of the principles of construction, iron bridges have almost entirely superceded the wooden ones.

The forms have been calculated and tested by years of practical use—and they are furnished by Bridge Cos. in lengths. to suit, and guaranteed to resist the stresses required. The finding of the jury in the Bussey Bridge disaster on the Boston & Providence is acknowledged to have been just, but the like will hardly occur with bridges as at present furnished—and subjected to careful inspection on the part of railroads. The limit of span has not yet been reached, nor perhaps the admissible height of skeleton piers nor any form of truss or suspension established as the best. Cantilevers from the ease of their erection without false works are largely used but esthetically in form they do not compare with the arch—yet extended use and knowledge of their "fitness for function," will soon reconcile one to the form.

GAS ENGINEERING.—much has been done by improvements in mechanics and chemistry to increase the product of gas and reduce its cost. Water-gas is largely manufactured and its uses extended in forging and welding. It is to be hoped that it may be distributed by mains throughout cities, for the purposes of heating buildings, etc. And although from experiment it has been demonstrated that water gas has but 65 per cent. of the thermie value of the coal from which it is manufactured, yet when the cartage and the storage of coal is taken into acount, together with the curtailing of hours of consumption by gas to the time necessary for the purpose, and the economy in the application of gas, there seems to be a fair presumption that sooner or later, water gas will be used for heating and cooking. In fact, from the great waste of heat in lighting by gas, and its cost, there perhaps might be some economy in converting the heat of water gas into power through an engine, and into light by a dynamo, rather than directly by carburreted hydrogen into light.

SANITARY ENGINEERING. Of late years, this branch of the profession has been recognized. It embraces the construction of sewers, the removal of sewage, its purification, or rather offense from it, and the plumbing, heating and ventilation of houses. The construction of sewers has long belonged to the department of hydraulic engineering, sometimes by the combined, and sometimes by the separate system, the general aim being to remove sewage speedily from the town or city, and to points remote from settled neighborhoods, and if possible, discharge it into a large body of flowing water. Of the offense in the matter of smell from sewage there is no doubt; but that it is so dangerous to life and detrimental to health as is often claimed, I have just doubt from a large experience and from evidence of experts before court.

I have said in the earlier part of my address that the engineer is born like the poet, sculptor, painter or any other artist, but that he is cradled on palpable material and nursed on facts, not metaphysical ideas, of "I think, therefore I am," or even the syllogism of the second order of differences; "I think, I think, therefore I think, I am;" but I am an engineer, and must think, and work. It is not necessary for him that he should believe either in the corpuscular or the wave theory of light, or in the atom whose weight is the first unit in the 22 place of decimals of a gramme, or that pressure is due to the immense velocity of atoms in motion, or that even bodies fall by attraction of gravitation or some later discovered force. If these present theories enable him to recollect facts, they serve their purpose. It is sufficient for the engineer to know the laws of force, to be able to resist or use them; $v = gt$ or $v = 2gs$ supplies him with the laws of gravitation even if he cannot understand the why.

The works of the engineer involve higher responsibilities than any other profession; he is to build, suitably, with materials at his disposals, solidly and securely for the prevention of accidents and for the protection of passengers, and economically in cost. He is to draw from his own and the experience of others, but he should not try experiments at another's cost, without a full understanding with the parties employing him.

As an expert, he must testify to facts, and the party who retains him must accept his facts, as they may be brought out in evidence, whether they are for or against them. It were better that the expert were attached to the court and not retained by either plaintiff or defendant. The construction of the law depends on the ruling of the judge. The value of the facts, from his point of view, should be settled by the engineer. As an umpire between the capitalist and contractor, his decision should be impartial, and if, by his own error, either party has been put to an unnecessary expense, acknowledge the fault, and, as far as possible, remedy it, but where such responsibility is taken, the pay should be commensurate.

From the position of the engineer as umpire between the capitalist and contractor, and his large employment and familiar intercourse with mechanics and laborers, he would naturally be the proper party to adjudicate in disputes between labor and its employer, and perhaps it would be so were the present troubles between labor and capital. But the strife is to see whether labor cannot support another class: chapters, president, officers, walking delegates and the like. These troubles come up in every country, and in every age, they are like the measles, hooping cough, fever, cholera, in the microcosm Ours, at present, is an imported disease, the symptoms of which, the suppression of the individual, boycott, etc., are entirely un-American. It is not our own labor, but the imported labor that is striving, not for a chance for labor, but rather for a life without labor. There is no country in the world where labor is so well paid, so well clothed, well fed and well housed. We have taken in an immense immigration, and still are, and have endeavored, by making them citizens, to assimilate them rapidly into our body corporate. This should be a question of time. It is a common phrase to say one has bitten off more than he can chew, how much more sad our case when we have swallowed more than we can digest. The great panacea seems to be land; some of us have worked land, and think if land were given to us instead of bread it would be the gift of a stone, but, if properly applied, it might relieve our present labor trouble. Let every immigrant be sent at once into the country and furnished a cabin and ten acres of land, without tax, as there is to be hereafter no titles to land, and support himself and family ten years on the land. At the end of that time the majority would prefer the work and wages of a day laborer, especially in the city, and all would be better citizens. Syndicates of labor are as proper organizations as syndicates of capital or of employers, and syndicates can only be met by syndicates. Properly organized they are not expensive and are efficient; but individuals should have perfect freedom to do as they please with their labor or capital, within the limits of law, and must be protected by law and a healthy public sentiment.

In the earlier part of my address I claimed for the origin of our name, Engineer, *le genie*—genius; but genius, inborn, is derived from the Greek *gune*, woman, and I trust that there is no profession which has a higher respect or greater love for that name than our profession, whether as mother, sister, wife, or companion in the halcyon days of youth, or, in maturer years, our origin, protection, comfort, and

inspiration. We trust that they will always attend our annual outings, intended not only for interchanges of views in matters of our profession, but also as a relief from business, a union for the establishing of a more general acquaintance, and cementing the bonds between the members of the A. S. C. E

The Secretary has furnished the following statement of the present (June 22) membership of the Society:

	Resident.	Non-Resident.	Total.
Honorary Members,	3	5	8
Corresponding Members,		3	3
	161	632	793
Associates,	11	34	45
Juniors,	28	92	120 958
		203 766	
Total			969
Fellows 64, of whom 6 Members are included, above, leaving			58
Subscribers to the Building Fund, 140, of whom 90 are entered in one or other of the above classes, and deceased, leaving			39
Total now connected with the Society			1066

Whence are we to draw our future membership to maintain the ranks of our Society: In answer, a distinguished professor and engineer has kindly furnished me the following statistics:

"There are in the United States 360 colleges and universities, which, besides classical and other courses, teach technology, and have given diplomas on technical professional subjects to 1,058 graduates. There are besides 49 schools, working under the 'Land Grant,' with 593 teachers and 4,644 students, of whom about 600 were technical graduates. In addition to these there are 39 private technical institutions with nearly 300 teachers and over 7,000 students, 800 of whom received technical diplomas. Statistics of this kind are very difficult to obtain, but it may be said that our higher schools of science turn out about 2,500 men per year, and of these about 7 per cent. are engineers."

It becomes us, who are conversant with the needs of our profession, to advise that before entering our technological institutes, students should have a good school training, such as is required in entering classical universities, and that within the institutes, they should know not only what to learn, but also how to learn. Then in their outer world progress, they may know how to accumulate knowledge useful to themselves in their profession, and reciprocate for the information and pleasure of those with whom they are thrown in contact.

PERSONAL.

E. J. SANFORD has been appointed Division Superintendent of the Kansas City division of the Chicago & Alton R. R.

J. T. JOHNSON, of Pittsburg, is to take charge of the Pittsburg & Western R. R. as General Superintendent.

ELLIOTT HALBROOK, late Superintendent of the New York & New England R. R., it is reported, will become General Manager of the Pittsburg & Lake Erie R. R. Mr. HALBROOK has now charge of the new shops of the Lake Erie, at Chartiers, Pa.

W. H. NEWMAN, General Traffic Manager of the Missouri Pacific system, rumor says, is to be made Third Vice-President and General Manager. OSCAR G. MURRAY, Freight Traffic Manager, is to succeed Mr. NEWMAN.

JOHN GIVAN, now Superintendent of the Iowa Div. of the Chicago, Rock Island & Pacific R. R., is reported as soon to succeed H. F. ROYCE as General Superintendent of the line. Mr. ROYCE is still occupying an important position on the road.

Prof. GEO. F. SWAIN, of the Massachusetts Institute of Technology, has been appointed Engineer to the Railroad Commission of Massachusetts. Mr. SWAIN'S duties will not include the inspection of bridges but the examination and investigation of strain sheets, etc., for the purpose of securing the proper proportions of parts.

SOCIETY PROCEEDINGS.

Am. Soc. of Civil Engineers.—As a result of the ballot counted at the meeting of July 13, the following were elected:

MEMBERS.

JOHN FERRIS ALDEN, (Rens. Pol. 1872). formerly Asst. Engr. upon Bridges over Hudson River, Albany, N. Y.; Asst. Engr. and Engr. in charge Leighton Bridge & Iron Works; now proprietor and Engineer Rochester Bridge & Iron Works, Rochester, N. Y.

FRANK MILLIGAN ASHMEAD, formerly engaged on construction Dutchess & Columbia R. R. in New York; Columbia & Port Deposit R. R., in Pennsylvania; Asst. Engr. Low Grade Div. Allegheny Valley R. R.; Engr. Dept. Bridges and Buildings Allegheny Valley R. R.; now Asst. Engr. Allegheny Valley R. R., Hulton, Pa.

WILLIAM HENRY BREITHAUPT, (Rens. Pol 1881). (Elected Junior June 4, 1884). formerly Asst. Engr. with C. Shaler Smith.; recently Chief Inspector of Kentucky & Indiana Steel Cantilever Bridge; engaged on Bridge Work on Missouri Pacific Ry.; Verdigris Valley, Independence & Western Ry., Nevada & Meriden Branch M. P. Ry.; Chicago, Rock Island & Pacific Ry.; Kansas City, St. Joseph & Council Bluffs Ry.; made designs and estimates for Viaduct and Bridge for Metropolitan Cable, Ry of Kansas City; now Chief Asst. Engr. on Superstructure of Sibley, Fort Madison and other Bridges, of Chicago, Santa Fé & California Ry., Kansas City, Mo.

HENRY THOMPSON DOUGLAS, formerly Asst., Rest. and Prin. Asst. Engr. Richmond & York River R. R.; Capt. Maj. and Lieut.-Col. and Colonel Corps of Engineers, C. S. A.; Div. Engr. Imperial Mexican Ry.; Chief Engr. Louisville, Cincinnati & Lexington R. R.; Chief Engr. Galveston, Harrisburg & San Antonio R. R.; Div. Engr. Chesapeake & Ohio R. R.; Engr. Maint. Way North Carolina R. R.; Chief Engr. Richmond York River & Chesapeake R. R. and Richmond & Danville System; now Chief Engr. Baltimore & Ohio R. R.

ULYSSES STANISLAUS LUTZ, (Phil. Pol. Coll. 1872). formerly engaged on Construction South West Penn. Ry.; Lewisburg & Spruce Creek Ry.; Asst. Engr. New River R. R.; Tyrone & Clearfield R. R.; Asst. Engr. Maint. Way Pennsylvania R. R.; Asst. Supervisor Pittsburg and Philadelphia Div. P. R. R.; Roadmaster Shenandoah Valley R. R.; Supt. Construction for Contractors West Shore R. R., between Weehawken Tunnel and Haverstraw; Senior Asst. Engr. South Pennsylvania R. R.; now Prin. Asst. Engr. Bloomsburg & Sullivan R. R., Bloomsburg, Pa.

JAMES MOORE SHANLY, formerly Asst. to Consulting Engineer Quebec Government Rys.; Asst. Engr. South Shore Ry. & Tunnel Co.; Rest. Engr. Montreal & Sorel R. R.; Contractor's Engr. Pontiac Pacific Junction Ry.; now Rest. Engr. Massena Springs & Ft. Covington R. R., Montreal, Canada.

Engineers' Club of Kansas City.—A regular meeting of the Engineers' Club of Kansas City was held Tuesday, July 5, 1887, at 8 P. M., in the Club Room, 19 Deardorff Building, Vice-President J. A. L. WADDELL in the chair.

Those present were Messrs. CLIFT WISE, WM. H. BREITHAUPT, J. A. L. WADDELL, OCTAVE CHANUTE, CLARENCE A. BURTON, A. J. MASON, A. E. SWAIN, JOHN DONNELLY, KENNETH ALLEN, and one visitor.

The minutes of the last meeting were read and approved.

On motion of Mr. OCTAVE CHANUTE it was voted: That the regular meeting of the club occurring Aug. 1 be omitted, and that in its stead the Club, on Mr. CHANUTE'S invitation, visit the work at that time in progress, of the crossing of the Chicago, Santa Fé & California Ry. over the Missouri river at Sibley.

It was suggested by the Secretary that resolutions of respect be drawn up for Mr. F. M. HARRIS, late member of the Club, but no action was taken. The memoir of Mr. HARRIS promised by Mr. L. E. COOLEY, not having been received, could not be presented as expected.

The Secretary presented for Mr. H. C. PEARSONS his regrets at finding it impossible to prepare the paper on "Standard Time," which he had promised.

Mr. WADDELL gave notes on some experiments on the strength of cast-iron cable yokes made in St. Louis recently by Prof. J. B. JOHNSON and himself.

At the request of Mr. MASON, the Secretary read abstracts from the annual address of the retiring president of the Engineers' Club of Philadelphia.

The Secretary presented for Mr. G. W. PEARSONS a set of excellent photographs, showing the progress of construction on the new Kansas City Water-Works at Quindaro and Kaw Point; also, from the American Society Civil Engineers' reports of the various committees on "Standard Time," with other papers referring to this subject.

CHAS. W. HASTINGS was proposed as member by WM. B. KNIGHT and E. B. KAY.

Adjourned. KENNETH ALLEN, Secretary.

STATISTICS OF NEW WATER-WORKS CONSTRUCTION.

(Specially Communicated.)

CONTINUED FROM PAGE 30.

Cornwall, Ontario.—The works were commenced in October, 1886, and accepted May 18, 1887, they were designed by F. S. PECKE, and O. W. WEED was Constructing Eng.; both connected with the firm of Moffett, Hodgkins & Clarke. WILLIS CHIPMAN, of Brockville, Ont., was Consulting Engineer. The contractors for the entire work were Moffett, Hodgkins & Clarke, of Watertown, N. Y., and the masonry, foundations, buildings, trenching and pipe laying were done by them; the pumping machinery was furnished by H. R. Worthington, New York; the pipe and specials, by Alex. Gartshore, Hamilton, Ont.; the valves by the Ludlow Valve Co., Troy, N. Y., and the hydrants by Chas. Smith & Co., Toronto; the stand-pipe was built by the Sharon Boiler Works, Sharon, Pa.; it is 120 ft. high and 20 ft. diameter. The franchise is owned by the Cornwall Water Works Co.; President, J. V. CLARKE; Secretary, H. C. HODGKINS; Superintendent, WM. STRICKLAND. The franchise is for 50 years and the hydrant rental is $50 per hydrant per annum. The present population is estimated at 6,000.

Salem, O.—The works are very nearly completed; they were designed by BOTSFORD R. CLARKE, of Boston, Mass., and H. F. DUNHAM, of Cleveland, O., was Constructing Engineer. The contractors for the entire work were Turner, Clarke & Rawson, of Boston, and the masonry, foundations, buildings, trenching, pipe laying and reservoir were done by them; the other contractors were; for pumping machinery, the Blake Manufacturing Co., New York; for pipe and specials, the Cincinnati & Newport Iron & Pipe Co., Newport, Ky.; for valves and hydrants, the Coffin Valve Co., Boston; for stand-pipe, Tippett & Wood, Phillipsburgh, N. J. The franchise is owned by the Salem Water Co.; President, B. S. AMBLER; Secretary, B. R. CLARKE; Superintendent, E. W. SILVER. The hydrant rental is $4,000 per annum. The present population is estimated at between 7,000 and 8,000,

New Philadelphia, O.—The works were commenced in August and completed in December, 1886; they were designed by W. S. KUHN. who was also Constructing Engineer. The contract for the entire work was taken by the American Water-Works & Guarantee Co., Muncie, Ind, There is no stand-pipe, but the supply is drawn from a reservoir. The franchise is owned by W. S. KUHN, who is President of the New Philadelphia Water-Works Co., which manages the works; Secretary, S. M. HIGHLANDS; Superintendent, D. C. HUFFMAN. The franchise is for 20 years, and the rental is $50. per hydrant. The population is estimated at 5,000.

NOTE.—The above statistics of new construction are sent in response to special inquiries sent out by us to contractors, superintendents, engineers and others having to do with new works. We have a special blank for this service, and will be pleased to forward one or more on application. We invite co-operation in this special subject.

(TO BE CONTINUED.)

CONSTRUCTION NEWS.

Water.

Chester, Pa.—On Monday, July 7th, Samuel R. Bullock & Co., of New York, deposited with the Chester National Bank, of Chester, Pa., a certified check for $313,000, this sum being the purchase money for the franchise and plant of the South Ward Water Works. Bullock & Co. are building extensions and improvements in the way of water supply, which, when completed, will represent an expenditure of at least $600,000. The aggregate money value of the extension and the old plant will represent a grand total of $2,500,000. Ample provision is made for the rapidly growing city, which is about annexing to its corporate limits, the boroughs of North and South Chester and Upland. All this territory will be supplied from the works being built by Samuel R. Bullock & Co.

New Water Works.—*Maine.*—Old Orchard. Work is now in progress. *New Hampshire.*—Hanover. The committee appointed to consider the question of water supply has reported in favor of a gravity system to cost $35,000.—*Massachusetts.* Whitman. An additional supply has been obtained by connecting the present source of supply with a large well.—*New York.* Castile. Propositions to put in water-works have been made by JOHN POST, of Washington.—Greenbush. Work is progressing rapidly. The water tower is being built, it will be 80 ft. high and 25 ft. diameter. The pumping engine will have a daily capacity of 3,000,000 galls. and direct pumping can be applied in case of emergency.—Cuba. The town has been contemplating putting in works for some time and has communicated with several contractors. There is abundant water. Population between 1,500 and 1,800 J. N. SHELDON is President of the village.—*Virginia.* Pocohontas. Water-works are contemplated.—*Tennessee.* Memphis. A proposition made by the Artesian Water Co. to furnish a supply has been referred to a committee.—*Kentucky.* Paris. M. DAVENPORT, of Charleston, W. Va., has made a proposition to put in

Sewers.—The following proposals were opened July 6, for the construction of sewers at Green Island, N. Y.; JOHN L. FITZ GERALD, of Landreth & Fitz Gerald, Schenectady, N. Y., is the Engineer in Charge.

	8-in. pipe laid.	10-in. pipe laid.	12 in. pipe laid.	15-in. pipe laid.	16 × 24-in. brick sewers.	20 × 30-in. brick sewers.	22 × 33 in. brick sewers.	6-in iron pipe.	Manholes.	Catch-basins.	Lamp-holes.	Excav. and backfilling under 5 ft.	5 to 6 ft.	6 to 7 ft.	7 to 8 ft.	8 to 9 ft.	9 to 10 ft.	10 to 11 ft.	11 to 12 ft.	12 to 13 ft.	13 to 14 ft.	14 to 15 ft.	15 to 16 ft.	16 to 17 ft.	17 to 18 ft.	Ad'l. price per ft. in length and depth for ditches in which brick sewers are laid.	Rock per yd.	Limestone masonry, per yd.	Earth filling, per yd.	Totals.
No. of feet...	3500	17040	7350	1900	1160	980	680	500	44	98	54	550	4470	500	22300	1150	1100	800	400	1000	200	100	50	150	100	27200	500	100	500	
CONTRACTORS.																														
B. Van Vranken & Co....	.30	.36	.48	.68	1.40	1.75	2 20	1.00	30.00	50.00	6.00	.12	.18	.20	.22	.35	.40	.45	.55	.60	.65	.75	.80	.90	1.00	.01	2.00	6.00	.20	$34,234.50
McConnell & Bassett.....	.32	.43	.54	.76	1.40	1.60	1.75	1.10	40.00	58.00	10.00	.14	.16	.18	.24	.25	.30	.35	.40	.45	.50	.50	.50	.50	.55	.13	2.50	5.00	.15	40,153.90
Sherman & McDonough	.29	.41	.52	.75	1.26	1.50	1.39	1.00	40.00	54.00	6.00	.20	.24	.36	.37	.52	.60	.70	.86	1.00	1.20	1.40	1.60	1.80	2.00	.01	1.30	6.00	.20	40,465.00
J. McEneroe..	.32	.39	.51	.73	1.95	2.30	2.60	1.10	50.00	65.00	9.00	.16	.20	.22	.25	.29	.35	.37	.43	.50	.60	.85	1.50	1 50	1.75	.02	3.5	12.00	.35	41,493.60
P. R. Chapman	.34	.45	.59	.79	1.40	1.55	1.61	.75	49.00	67.95	7.00	.19	.24	.29⅓	.39⅓	.59⅓	.66¾	.69⅓	.79⅓	.89⅓	.99⅓	1.09⅓	1.19⅓	1.29⅓	1.39⅓	.03	1.75	6.50	.30	45,012.45
J H Cavanaugh	.32	.45	.62	.82	1.45	1.75	2.00	1.25	60.00	90.00	9.00	.20	.30	.37	.40	.60	.80	1.00	1.20	1.50	1.65	2.00	2.50	3.00	3.25	.02	4.00	15.00	.40	52,811.00

works at a cost of $100,000.——Covington. Work has been commenced on the pipe laying by Thomas McRae, contractor.——*North Carolina.* Raleigh. The new works have been tested.——*Georgia.* Washington. There will be a tank with a capacity of about 75,000 galls' on a brick or iron tower 75 ft. high.——Messrs. JETER & FOARDMAN, of Brunswick, propose to build water-works at Thomasville, Americus and Griffin.——Macon. The five years contract with the Macon Gas & Water Co. has been signed by the mayor.——*Alabama.* Bessemer The Bessemer Land & Improvement Co. will build the water-works at once.——*Michigan.* Grand Rapids. All the bids for the water-works at the Soldiers' Home were higher than the appropriation and the managers have ordered the pipe and materials and will undertake the work.

Proposals Open.

Water-Works.—Franchise to be granted; the city will take 50 to 65 hydrants. JAS. E. WHARF, Mayor, Olney, Ill.

Bridge Masonry.—Four piers, 1,500 yds. of range work. KANSAS CITY BRIDGE & IRON CO., Kansas City, Mo.

Meigs Elevated Railroad.—Iron work for 8 miles. Price per pound. JAS. L. MEIGS, Chief Engineer, Meigs Elevated Railway Construction Co., Boston, Mass.

Paving.—Medina sandstone paving and stone curbing. S. H. SHEARES, City Engineer, Indianapolis, Ind. July 18.

Pile Driving.—For building about 500 ft. of wooden culvert at Brookline, Mass. Plans and specifications at the office of Aspinwall & Lincoln, Civil Engineers, Boston. WM. ASPINWALL, Chairman of Committee, 12 Pearl street, Boston, Mass. July 20.

Artesian Well.—About 1 500 f deep. JOHN F. CONN, Henrietta, Tex. July 20.

Jail.—Plans and specifications at County Clerk's office, Ashland; 20 cells. B. J. ARMSTRONG, Chairman, Committee on Jails, Ashland, Wis. July 20.

Boilers.—Five horizontal tubular boilers. Plans and specifications on file. W. B. SHOCKLEY, Treasurer, National Military Home, Leavenworth, Kan. July 20.

Sewer Work.—A. B. HILL, City Engineer, New Haven, Conn. July 20.

Street Work.—Grading, curbing and paving. A. E. SMYRE, City Commissioner, Baltimore, Md. July 21.

Laying Water-Pipe.—Trenching, pipe-laying and backfilling: from Hope pumping station to near the proposed Fruit Hill reservoir, THE BOARD OF PUBLIC WORKS, Providence, R. I. July 21.

Masonry.—At Pier A, North river. Granite, "eight-cut" and "pean hammered," for coping, steps and curb; bluestone pavement: concrete; 12-in. clay drain pipe. THE DOCKS COMMISSIONERS, Pier A, North river, New York City. July 21.

Building.—Superstructure of south wing of prison. Architect, E. M. BUTZ, Pittsburg. THE BOARD OF INSPECTORS, Western Penitentiary, of Pennsylvania, Pittsburg, Pa. July 22.

City Work.—Taking up and relaying pavements; regulating, grading, curbing and flagging; sewers. THE COMMISSIONER OF PUBLIC WORKS, 31 Chambers street, New York City. July 22.

Removing Ledge.—Blasting and removing ledge from Moosabec Bar, near Jonesport, Me. Major JARED A. SMITH, U. S. Engineer Office, Portland, Me. July 23.

Dredging.—At Cuylers Bar, 14,000 cu. yds.; at Overslaugh Dyke, 10,000 cu. yds.; at New Baltimore, 8,000 cu. yds. JAMES SHANAHAN, Superintendent of Public Works, Albany, N. Y. July 25.

Street Work.—Oblong granite block pavement, Belgian bridge stone. JOHN HUNKELE, Street Commissioner, Newark, N. J. July 25.

Brick Paving.—Vitrified fire clay brick street pavement, 13,000 sq. yds.; also vitrified paving brick. J. M. RENO, City Engineer, Youngstown, O. July 27.

Dredging.—In Calumet river, Major THOS. H. HANDBURY, U. S. Engineer Office, Chicago, Ill. July 29.

Water-Works.—Engineer, A. A. RICHARDSON, Lincoln, Neb. THE CITY CLERK, Valparaiso, Neb. July 30.

Bridge.—Masonry and iron superstructure. FRED. RAINE, County Auditor, Cincinnati, O. July 30.

Street Work.—Excavation, curbing, paving, vitrified pipe, basins, etc. P. C. HILLIARD, Chairman, Committee on Streets and Sewers, Board of Public Works, Jersey City, N. J. Aug. 1.

Steel Guns.—Three steel-cast, rough-bored and turned 6-in. rifle guns; one of Bessemer, one of open hearth, and one of crucible steel. Specifications may be obtained at the Bureau of Ordnance, Washington. Hon. WM. C. WHITNEY, Secretary of the Navy, Navy Department, Washington, D. C. Aug. 2.

Sewers.—On the line of Rosedale creek and on Bloor street. Approximate cost, about $160,000. W. CARLYLE, Chairman, Committee on Works, Toronto, Canada. Aug. 2.

Wharves.—Lumber, piles, spikes and bolts. E. MAY, Pay Director, U. S. N., Post Office Building, Boston, Mass. Aug. 4.

Dredge Hull.—Wooden hull, 84 ft. by 24 ft. by 6 ft. 4 ins. Major AMOS STICKNEY, U. S. Engineer Office, Louisville, Ky. Aug. 9.

Bridge.—Iron highway bridge, span, 175 ft. Plans and specifications on application. J. J. SHAW, County Clerk, Troy, Mo. Aug. 9.

Contracting.

Reservoirs.—The contract for the two reservoirs for the water-works now being built at Bismarck, Dak., has been awarded to Mayouck & Byrne, of Bismarck.

Slag Paving Blocks.—A syndicate of Philadelphia capitalists have placed a plant in the Pottstown Iron Company's furnaces for the manufacture of building and paving blocks from the slag.

Granite Blocks.—M. T. Jameson & Co., South Thomaston, Me., have a contract for granite paving blocks for Cincinnati, O.

The Red River Construction Co. has been incorporated at Chicago by W. L. WHITAKER, JOHN C. OBRICK and F. F. HINCKLEY, to build railroads and bridges. Capital stock, $100,000.

The United States Railroad Construction Co. has been incorporated by FREDERICK S. FISH, of Newark, N. J.; G. P. ERHARD, Elmira, N. Y., and THORNDIKE SAUNDERS, of Long Branch, N. J.

Pipe and Castings.—At Washington, D. C., the following contracts have been awarded: Cast-iron pipe Camden Iron Works, 9,000 ft. of 12-in. pipe, $10,530; 10,000 ft. of 6 in., $4,860; 15,000 ft. of 4-in., $4,482; 10,000 ft. of 3-in., $2,371.75. Special castings, J. T. Springman & Son, 1,000 pounds for $2,506.

The Wainwright Manufacturing Co., 65 and 67 Oliver street, Boston, with works at Medford, Mass., reports large sales of its corrugated tube exhaust feed-water heaters in this country and abroad. Two of 1,000 H. P. each, are now being built for the Lucy furnace, Messrs. Carnegie, Phipps & Co., Pittsburg, Pa. The company has recently appointed Señor V. DE LA CALLE, of Matanzas, as its agent in Cuba for the sale of its manufactures, viz.: corrugated tuting, feed-water heaters, filters, expansion joints, radiators and purifying plants for preventing the formation of scale in boilers.

Paving and Sewers.—The following were the lowest bids received July 6, by A. B. HILL, City Engineer, New Haven, Conn.: Belgian pavement, $1.72 and $1.75 per sq. yd.; tar concrete, J. H. McDonald, 70 cts. per sq. yd.; sewers, J. H. Austin, 12-in. vitrified pipe sewer, $1.34 per ft.; 12-in. vitrified pipe culvert, $1 per ft.; catch basins, $100; receiving basins, $16; manholes, $48. Several large sewer contracts will be let July 20.

Dam.—Bearce & Clifford, of Lewiston, Me., have been awarded the contract to build a new stone dam on the Little Androscoggin river, for the Little Androscoggin Water Power Co., of Auburn, Me. The dam is to be completed by October 1.

Pumping Machinery.—The Volker & Felthousen Manufacturing Co., of Buffalo, N. Y., has been awarded contracts for pumping machinery for the water-works at San Jose, Cal., and at Garden City, Great Bend, Oswego and Marion, Kan. The company is crowded with work and reports a rapid increase in its pump business.

Boiler Tanks and Castings.—The following contracts have been awarded at Allegheny, Pa.: Boiler, D. W. C. Carroll & Co., Pittsburg, $755; two tanks, Riter & Conley, Pittsburg, $4,550; sewer castings, Thos. Carlins' Sons, Allegheny, $1.75 per hundred.

Manchester Ship Canal.—The contract has been awarded to T. A. Walker for the complete construction of this English canal for a sum which is said to be $2,805,000 less than the Parliamentary estimate. The contractor will take, if requested, $2,500,000 in ordinary $50 shares, as part payment.

The Ohio River, Concord & Tollesboro Turnpike Road Co. has been incorporated at Maysville, Ky., by H. C. BARCKLEY, Asa R. BURGESS and others, with a capital stock of $10,000.

Artesian Well.—The American Well Works, Aurora, Ill., have the contract to sink a well for the Texas & Pacific R. R. Co. at Bonham, Tex.

Jail.—A new jail is to be built at Centralia, Ill. Address the Police Committee.

The Nashville Reservoir.—It is reported that a number of applications have been received from New York, Chicago and Pittsburg contractors for the specifications of the new masonry reservoir. It is thought there will be about 4 local bids and 10 or 12 outside bids. The work is advertised in our columns. Address J. A. JOWETT, City Engineer, Nashville, Tex.

The Kansas City Switch & Frog Co. will remove its works from Randolph to Blue Valley, near Kansas City, and work has been commenced on the buildings. The site has a frontage on the Blue river and will have connections with the Kansas City & Southern R. R. and the Paola branch of the Missouri Pacific, both of which are to be in operation by January. The company will manufacture frogs, switches, bridges, etc. President, C. H. TALMAGE; Vice President, C. L. DUNHAM; Secretary and Treasurer, J. H. PICKERING; Superintendent, E. J. REMILLION.

Street Work.—*Boston, Mass.* The following proposals have been received by the Park Commissioners for setting curbstone and paving gutters respectively: James A. Colson, 20 cts. per lin. ft.; 30 cts. per sq. yd.; F. S. Gove, for Gove Bros., 25 cts., 40 cts.; Albert A. Libby & Co., 30 cts., 50 cts.

Allegheny, Pa. The Committee on Streets and Sewers has awarded the contract for crossing stone to McNaugher & Co., at 39 cts., per ft., and for gravel to T. R. Clark at 4 cts. per bushel.

Little Rock, Ark. The contract for concrete walls in Sidewalk District No. 2, has been awarded to Murphy & Weiderman, at 18½ cts. per sup. ft.

Montreal, Canada. The following contracts have been awarded by the Road Committee: F. D. Lawrence, stone curbing, straight and circular, 73¾ and 79¼ cts. per lin. ft.; sidewalk flagging (New York bluestone,) $3.50 and $3.60 per sq. yd. Robert Forsythe, stone curbing, 75 and 80 cts. per ft. for straight and circular; sidewalk flagging (Stewart's granolithic pavement), $3.30 per sq. yd.

Richmond & St. Louis.—Incorporated in Indiana by D. J. MACKEY and others to build a railroad from Elnora, Daviess county, through Knox county to the State line.

Penobscot Central.—The directors of this Maine company have appointed W. T. PEARSON, of Bangor, and two others, a committee to confer with parties concerning the building of the road, provided present negotiations with the Bangor & Piscataquis fail.

Southern

Existing Roads.—*Birmingham & Atlantic Air Line.*—Six hundred hands are now at work on the line from Dublin to Savannah.

Savannah, Florida & Western.—The surveyors are at work on the extension to Tallahassee and Monticello, Fla. The portion of the road from Thomasville to the Georgia State line will be put under contract by Aug. 1. The grading of the two branches from the State line is to be done by the respective towns, and the Savannah, Florida & Western will equip and operate the lines. S. G. MCLENDON, of Thomasville, is interested.

Laurel Fork & Sand Hill.—Operations have been suspended over this short road, running from Laurel Fork Junction, on the Baltimore & Ohio, to Volcano, W. Va.

Savannah, Griffin & North Alabama.—The Central Railroad & Banking Co., of Georgia, who hold a mortgage on this line, have begun foreclosure proceedings and will acquire the property. This is the line which the Central is now extending from Carrollton to Decatur, Ala.

Mobile & Girard.—The stockholders have voted a 20-year lease to the Central R. R., of Georgia. It is stated that the line will be extended at once in opposition to the Alabama Midland scheme.

Macon & Covington.—Grading begins at once on the line from Madison to Athens, Ga.

Georgia, Midland & Gulf.—The line has been opened for business from Columbus to Griffin. The grading on the Columbus Southern line will probably be begun by Aug. 1.

Atlantic, Greenville & Western.—The stockholders have voted in favor of a consolidation with the Carolina, Knoxville & Western, which is to run from Knoxville, Tenn., southeast.

Norfolk & Western.—A contract on the Clinch Valley extension has been let to SAMUEL WALTON, of Graham, Va. There is much heavy bluff and tunnel work on the line, and several bridges. The whole distance to the connection with the Louisville & Nashville will be about 120 miles. J. C. RAWN is the Engineer in Charge.

Chattanooga, Rome & Carrollton.—The citizens of Chattanooga, Tenn., are much exercised because work on this line is not being pushed as they expected.

New Projects and Surveys.—*Lynchburg & Durham.*—Hon. PETER J. OTEY, President, writes us confirming our statement of last week, and stating that $646,000 has been raised for building the line, and that the first contracts will be let Aug. 15.

Macon & Tuscaloosa.—Right of way is being obtained for this road, which is to run from Macon, Miss., to Tuskaloosa, Ala.

Tuscaloosa Northern.—The first ten miles of this Alabama road have been put under contract. H. H. PECK is President.

Pensacola & Memphis.—The officers of this company, which proposes a line from Meridian, Miss., to Pensacola, Fla., are L. H. SELLARS, President, and S. N. VAN PRAAG, Secretary.

Paris, Georgetown & Frankfort.—Franklin Co., Ky., has voted $150,000 to this company.

Knoxville Southern.—The Finance Committee of the city of Knoxville, Tenn., have voted to submit to the city the proposition to subscribe $275,000 to the stock of this company, whose line is to be built to connect with the Marietta and North Georgia. Also the proposal to subscribe $225,000 to the Powell's Valley R. R., to be built from Knoxville to Cumberland Gap.

South Florida & Georgia Air Line.—W. H. SEBRING, of Jacksonville, Fla., and Jos. TILLMAN, of Quitman, Ga., are going over the proposed line of this road, obtaining subscriptions and right of way. The line is to run from Atlanta, Ga., through central Florida to the Gulf. H. M. DRANE, Savannah, Fla., is President and W. H. DIAL, Madison, Fla., Secretary.

The Northwest.

Existing Roads.—*Red River Valley.*—It is stated that the Provincial Government found some difficulty in negotiating the bonds which were issued for the construction of this line, and that Premier NORQUAY was finally assisted in placing the securities by Grand Trunk and Northern Pacific influence.

Jacksonville Southeastern.—Centralia, Ill., has granted this company right of way for an egress from the city, on condition that they build the line to Mt. Vernon before Jan. 1., and permit the Centralia & St. Genevieve to come into the center of the city by granting them a right of way on Locust street where the Jacksonville Southeastern owns a franchise. The Louisville, Evansville & St. Louis will enter the city over the same route.

Northern Pacific.—A temporary pontoon bridge has been erected at Grand Forks, Dak., over which construction trains are now running with material for the extension to Pembina. The repairs to the Mullan tunnel are completed and trains are running through it as usual.

St. Paul, Minneapolis & Manitoba.—Grading is being pushed on the Brainerd & Northwestern line from Crookston, Minn.

Chicago, Milwaukee & St. Paul.—Track laying is reported in progress at the rate of two miles per day on the line running from Lake Preston, Dak., north to Bristol.

Chicago, St. Paul & Kansas City.—Real estate has been purchased for the terminus at St. Joseph, Mo. The yard will be 2,070 ft. in length and 250 in width, with shops and round house occupying two acres at the entrance. The general offices are to be located on Main street. The company has also purchased real estate across the river in Kansas, which is thought to indicate an eventual southwestern extension.

Aberdeen, Bismarck & Northwestern.—Grading on this Dakota road is making satisfactory progress. A preliminary survey is to be made at once for a branch from Napoleon to the coal fields in McLean county.

New Projects & Surveys.—*Mississippi, Fairbault & Northwestern.*—This company has been incorporated with a capital stock of $6,000,000 by HUDSON WILSON and others of Fairbault, Minn., to build a railway from the Mississippi river northwest, *via* Fairbault and Willmar, to some point on the western line of the State.

Forest City & Watertown.—President P. M. SPRINGER, of Forest City, Dak., has been notified by the Secretary of the Interior that the maps of right of way for this road have been referred to the Commissioner of the General Land Office for approval.

St. Paul Black Hills & Pacific.—This company has been incorporated in Dakota to build a railroad from Cass county to the Montana line and from Aberdeen to La Moure. S. H. JUMPER is President and L. G. JOHNSON, General Manager. For the road from Aberdeen to La Moure, the company will purchase and complete the partly graded line of the old James River Valley road.

Duluth, Pierre & Black Hills.—It is stated that this company has been absorbed by the Manitoba, and that grading will begin this month. The line is to run from Aberdeen *via* Faulkton to Pierre, on the Missouri.

The Southwest.

Existing Roads.—*Chicago, Milwaukee & St. Paul.*—A Western oracle confides the following: "It has leaked out that this company is behind the schemes of building three lines out of St. Joseph—one to go to Winfield, Kan., another to Little Rock, and a third to Trinidad, Col." We can not help wondering who can have been so leaky as to give away this important information.

Chicago, Burlington & Quincy.—Of a similar sort with the preceding is the tale from a Ft. Worth, Tex. paper that this company has decided to extend its lines to that city. Of an officer of the company who spent several days in Ft. Worth recently, it says: "The gentleman was not open to interview by newspaper men, but to Mr. ROBERT MCCART he stated without any injunction of secrecy, that the company not only *wanted* to build to Ft. Worth but was *compelled* to do so, and the present year would see the extension under way." It is really too bad that anyone should be *forcing* the Burlington to build 500 miles of road. Can't the Interstate Commerce Commission remedy this wicked compulsion.

San Antonio & Aransas Pass.—The survey is just completed of a branch from Beeville to San Diego, Tex.

Kansas City, Wyandotte & Northwestern.—The line from Holton to Seneca *via* Wetmore is under survey.

Atchison, Topeka & Santa Fé.—The Kiowa extension has been opened for business from Kiowa, Kan., across Indian Territory to Higgins, just across the Texas line, a distance of 120 miles. This is the line which is to so shorten the distance to El Paso and, *via* the Mexican Central, to the City of Mexico, as to enable the latter line to compete with the Mexican National when that line shall be completed.

Missouri Pacific.—The Ft. Scott, Wichita & Western is to succeed the St. Louis, Fort Scott & Wichita. It is stated that the company will build a line from Wetmore, Kan., to Wamego.

St. Louis, Kansas City & Colorado.—Location is reported complete from Sedalia to Versailles, Mo.

New Projects and Surveys.—*Desha & Eureka Springs.*—This company has been incorporated in Arkansas by G. P. BANKS, of Boston, Mass., and others, to build a railroad from Pendleton to Eureka Springs, about 210 miles.

Denver, Russell Springs & Southwestern.—Incorporated in Kansas by D. M. RICHARDSON, of Denver, Col., and others, to build a railroad from Denver to Russell Springs, Kan., with two lines running to Fort Worth, Tex., and to other cities in western Kansas.

Chicago, Jefferson City, Girard & El Paso.—This company, which was chartered in Missouri last spring, has filed articles of incorporation in Kansas. Its line is to run from Jefferson City, Mo., to El Paso, Tex. W. B. Gow, of Chicago, Ill., is interested.

Memphis, Kansas & Western.—The survey of this line, which is to run from Cherryvale, Kan., to Neosho, Mo., is in progress, under direction of R. M. WHITMAN.

Little Rock & Alexandria.—It is again stated that this Arkansas road, of which B. W. JOHNSON, of Camden, is President, is to placed under survey at once.

Rocky Mountain and Pacific.

Existing Roads.—*Atchison, Topeka & Santa Fe.*—While the company are pushing work on their line to San Diego, it is not probable that it is on account of any intention to make that city the principal seaport for the system. Port Ballona is situated on Santa Monica bay only 30 minutes distant from Los Angeles and a line to that point is nearly completed. At the port a large pier is being constructed and the entrance channel is being dredged. It is believed that the company will put on a line of steamers to San Francisco, making the trip in 24 hours. The company has contracted with the city of San Jacinto to build a line to that place at once, running from Ferris station on the California Southern, up Pleasant Valley *via* Winchester, about 20 miles. The problem of whether the Atchison intends to build to San Francisco or not, which has deeply interested that city for some time, has received new interest from the purchase of an option on a mile of the Alameda water front by J. H. WOODWARD. As that gentleman, however, chooses to keep his purposes and plans regarding the purchase to himself, it is left for San Franciscans to ruminate on whether the purchase is for the Santa Fé or if not, who it is for. On the Denver & Santa Fé line, tracklaying is being pushed.

Pacific Coast.—A large force is grading the extension from Los Alamos to El Olivar.

Colorado Midland.—A vague rumor has been in the air, that this company has purchased the Denver & Rio Grande Western.

Southern Pacific.—Now that the Union Pacific has "dissolved partnership" with the Central Pacific line and prefers its Oregon Ry. & Navigation connection for Pacific business, it is proposed that the Central Pacific extend its line east to Denver where it can meet a half dozen of the great railway systems and compete most effectively for San Francisco business. Inasmuch, however, as several of these companies are likely to extend to a Pacific connection on their own account before very long, it is likely that the Central Pacific will continue to terminate at Ogden.

The following account of work on the Oregon & California, we condense from the San Francisco *Examiner*:

The construction of the Oregon & California road is progressing with great rapidity. The track is laid to the summit of the Siskiyous. The entire grading force, containing over 3,000 men, is now employed on the north side of the mountain, and the grade is being pushed at a marvelous rate of speed.

There are to be four tunnels between the State line and Ashland, and these will necessarily delay the track to some extent, though work is progressing very favorably in them. The contract for three of the tunnels has been let to the firm of Hale & Smith, of Ashland, and the fourth, a short one, will be built by the company. Hale & Smith are working night and day on the Siskiyou tunnel, having three gangs working eight-hour shifts, and it is now nearly finished, there remaining only 700 ft. out of 3,100 ft. At the present rate of speed, about 30 ft. a week at each end, it will take between two and three months to finish it.

Their other tunnels are located at Cougar Gulch, one being 1,400 ft. in length, and the other 202. They are pretty well under ground on the 1,400-ft. tunnel, but have not commenced on the small one yet. The fourth and last one, between the State line and Ashland, is also a small one—400 ft. in length. The company has already commenced work upon it, and are hurrying it through. The general opinion is that the entire road will be completed by the last of November.

The descent from the summit of the Siskiyous to Ashland is a masterpiece of engineering skill. From the north end of the summit tunnel the line runs along the side of the hill for three miles. Then it enters Cougar Gulch tunnel, and there turns completely around and goes back on its former course, on a line just below it. In one place the two lines are only 27 ft. apart. After running on this line for three miles, it again reverses and takes a new course parallel to its former line to Oviette Gap, and from there makes a comparatively straight line to Ashland.

The grades and curves on this road are the heaviest in use by the company, the maximum grade being 3.3, or a rise of 172 ft. in the mile, while the maximum of the Central Pacific Railroad is 2.2, or a rise of 116 ft. in a mile. The curves, too, are extremely sharp, 14° being the maximum curve. Those on this road were the first used by the company.

New Projects and Surveys.—*Colorado Northern.*—This company, whose headquarters are at Greely, has elected J. M. WALLACE, President, and GEO. H. YOUNG, General Superintendent. Some work has already been done in surveying and securing right of way.

Eastern Wyoming.—Articles of incorporation have been filed in Laramie County by this company, for a line to be built through Carbon and Sweetwater counties. It is thought to be in the interest of the Chicago, Burlington & Quincy.

Mexico.—A line is to be built by an English company from Jiminez, on the Mexican Central, 93 miles south of Chihuahua, to Guadalupe y Calvo.

Dredging and Crib.—Proposals for opening a channel between Great Salt Pond and the ocean and building a crib protection to same, have been received by H. S. MILLIKIN, on behalf of the Town Council of Block Island, R. I., from J. A. Dailey & Son, Providence, R. I. and S. V. R. Kendricks, East Hampton, Mass. The contract was awarded to J. A. Dailey & Son, for $9,350, this being the lowest bid.

Globe Specials.—The Builders' Iron Foundry, Providence, R.I., has orders this season for globe specials for water-works at the following places: Braintree, South Braintree, Taunton, Hyde Park, Belmont, Marblehead, Marlboro, Lowell, Ware, Cohasset, Fitchburg and Grafton, Mass.; Belfast, Bath, Presque Isle and Old Orchard, Me.; Manchester, N. H.; Pawtucket, R. I.; Xenia and Salem, O.; Patchogue, Far Rockaway and Jamaica, L.I.; Binghamton, Jamestown and Gowanda, N. Y.; Danielsonville, Conn.; Paterson and Montclair, N. J.; Osage City and Council Grove, Kan., and Janesville, Wis.

Iron Pier.—The following proposals for the construction of an iron pier at Marine Park, were opened July 8, by the Board of Park Commissioners, Boston, Mass.: Builders' Iron Foundry, 26 cast-iron pier piles, $37.50 per lin. ft. of pile; 12 spans of superstructure, $37,700 complete; 10 additional cast-iron pier piles, $37.-50 per lin. ft. of pile; 5 additional spans of superstructure, $15,990. W. G. Coolidge & Co., Chicago, $38.75, $39,-200; additional work, $38.75, $16,750. Boynton Bros., $42,-60, $34,800; additional work, $42.60, $14,500.

The Standard Cement Co.—The name of the Standard Cement Company has come into unfortunate prominence lately through the failure of Hubbard & Farmer, and there is considerable inquiry about it. A reporter for *The Courant* called at the company's office yesterday (July 7) but its officers were out of town. However, he was able to learn something of it from other sources. It was organized in 1884, and has a capital of $750,000, of which about $300,000 is owned here in Hartford. A number of well known business men have as much as $10,000 apiece in its stock and the Connecticut Life Insurance Company had over $200,000 by its last statement. The company has three sets of works—two in New York state, one near Buffalo and the other at Akron, and one at Mankato, Minn., where the rock is mined and then put through the process that makes it cement. The Akron works (the largest) are running twenty hours a day, producing about 2,000 barrels daily. The cement is in large use on the aqueduct in New York and has been used very acceptably in government work. Specifications printed and issued by the United States treasury department demand cement equal in quality to that manufactured by this company. Its quality has received many high endorsements. Those interested in the company, and some persons, seen by the reporter, who had no interest in it, were outspoken in their belief that it would prove a profitable concern. The officers of the company are J. H. VERMILYE, President; R. W. FARMER, Treasurer, and W. G. PARSONS, Secretary.—Hartford (Conn.) *Courant*.

Contract Reawarded.—At Washington, D. C., the Commissioners have reawarded to James Reynolds the contract for grading and regulating Virginia avenue southeast. The contract was originally awarded to Reynolds in August, 1886, but never carried out for the reason that no funds were available for the work. When the new schedule of street improvements was advertised recently this avenue was included, and Wm. Buckley, who bid $9,763, was awarded the contract. Mr. Reynolds filed an objection, stating that as it was through no fault of his that he was prevented from carrying out his contract, it should be properly awarded to him. The Commissioners perceived the justice of Reynolds' request and reawarded it to him. His bid is $9,463.47.

New York City.—*Street Work.*—The following contracts were awarded July 8 by the Commissioner of Public Works: Regulating and granite block paving on Cherry street; P. H. McCullagh, pavement, $2.57 per sq. yd.; bridge stone, 49 cts. per sq. ft.; total, $22,433. On Bedford and Hester streets; (the lowest bid was informal and the contract was not awarded). On Crosby street; John G. Smith, $2.58, 52 cts., $18,476.40. On Ninth avenue; Wm. A. Cummings, $2.53, 47 cts., $10,530.10. On 15th street; John G. Smith, $2.50, 43 cts., $16,583. On 72nd street; Chas. Guidet, $2.56, 48 cts., $11,404.40. Regulating and trap block paving on 15th and 20th streets: P. H. Fitzgerald, pavement, $2.39 per sq. yd., $12,929.90. On 26th, 36th and 41st streets; Matthew Baird, $2.55, $11,730.

Paving.—At Indianapolis, Ind., an ordinance has been passed providing for regrading, stone curbing and Medina stone paving on Washington street, between Mississippi and Alabama streets; about 26,400 sq. yds. There will be a hydraulic concrete foundation, covered with 2 ins. of sand upon which will be laid the stone blocks, with joints filled with gravel and grouted with pitch: the blocks will be 3 to 4½ ins. thick, 7 to 14 ins. long and 6 ins. deep, dressed to shape. The curbing will be of limestone, 4 ft. long, 28 ins. wide and 5 ins. thick. Profiles and cross-sections can be seen at the office of S. H. SHEARER, City Engineer. The contract will be let as a whole, including grading, on July 18. The viaduct work will be let in about a week.

Iron and Steel.—The following proposals for iron and steel for Lock No. 2, of the Great Kanawha River Improvement have been received by Col. WM. P. CRAIGHILL, U. S. Engineer Office, Charleston, W. Va.: Ainslie, Cochran & Co., Louisville, Ky.; wrought-iron, 6.5 cts. per pound, $2,795; cast-iron, 5 cts., $1,125; steel, 12 cts., $264; total, $4,184. Builders' Iron Foundry, Providence, R. I., wrought-iron; 6.14 cts., $2,640.20; cast-iron, 6.5 cts., $1,462.50; steel, 15.5 cts., $341, total, $4,443.70. Queen City Bridge & Steam Forging Co., Cincinnati, O., wrought-iron, 7.2 cts., $3,096; cast-iron, 5.2 cts., $1,170; steel, 16 cts., $352; total, $4,618. The contract was awarded to Ainslie, Cochran & Co. The quantities called for are 43,000 pounds of wrought-iron, 22,500 pounds of cast-iron, and 2,200 pounds of steel. The work was not advertised east of the Allegheny mountains, so as to secure cheapness of transportation and economy of inspection.

Minneapolis Sewer Tunnel.—Work is progressing on the North Minneapolis sewer tunnel rapidly and satisfactorily. Last week 75 ft. were excavated and completed, the fastest work yet done, and at this rate Engineer RINKER's estimate of $18 per ft. will be exceeded. The digging northward has been entirely confined to sand rock. East, dynamite blasting breaks enough sand to enable the crew to dig out about 12 ft. The air in the tunnel is good, and the crews have no trouble in working 8 hour shifts. The tunnel is now completed about 400 ft. from the shaft, and has passed Second avenue north. At the present rate of construction the tunnel would be completed to its terminus, at Sixth street and Fifth avenue north, by about the 1st of November. Supt. EDWARDS does not calculate on having such smooth sailing all the way through, however. After getting north of Fourth avenue, it is expected that the work will be retarded by water.

The Westinghouse Engine.—The Dodge Paper Co., Delphi, Ind., has made a radical departure in the disposition of power at the new mill, which is giving most satisfactory results. Line shafting is practically done away with and each beater, calendar, etc., is driven by independent power. The beaters are arranged in pairs with a Westinghouse engine of 75-H. P. between each pair coupling right and left directly to the beater shaft The couplings are flexible allowing for the raising of the rolls. Independent engines are similarly connected to the machines, calendars, etc. This plan looks to a very considerable saving in first cost, and particularly to economy of power and fuel.——The Westinghouse engine applied in the same manner has met with great favor in paper mills throughout Great Britain.——The Hitchcock Carriage Co., Cortlandt, N. Y., has adopted independent power for the new factory. No overhead shafting is used, but the main line shaft runs underneath the floor. A 100-H. P. Westinghouse engine is set in a pit so located that the engine couples direct to the shaft at about its center. Main belts and pulleys are dispensed with and the counter-shafts and belts are underneath the main floor leaving the head-room entirely free.

RAILROADS.

East of Chicago.

Existing Roads.—*Ohio & Northwestern.*—The company has completed the work of widening cuts and fills on its line from Cincinnati to Portsmouth preparatory to a change of gauge, which will be effected about August 1. The Columbus & Maysville Ry. has been reorganized in this company's interest, and extensions are proposed from Georgetown to Maysville, and Hillsboro to Columbus. For the latter extension three routes are proposed, one *via* Washington and thence over the Columbus & Cincinnati Midland, another by Chillicothe and the Scioto Valley, and a third route wholly independent of existing lines.

Boston & Maine.—The Lake Shore line, from Alton Bay to Lake Village, N. H., will be located and built at once according to a vote of the directors. It is possible, however, that this is merely a bluff game to influence pending legislation at Concord.

Cleveland & Canton.—President BLOOD is reported as saying, that the 30 mile extension from Coschocton to Zanesville will be completed by Jan. 1.

Delaware & Hudson Canal Co.—A short line is to be built to give a more direct route to the connection with the Fitchburg at Ea. le Bridge, N. Y. The line will run from Fairhaven to Poultney or from Whitehall to Granville.

St. Louis, Vandalia & Terre Haute.—A bill has been filed to annul the lease of this road to the Terre Haute & Indianapolis, as we predicted would be the case when the Ives-Staynor syndicate secured control of the latter company.

Bell's Gap.—Grading is in progress on the extension from Mahaffey to Punxsutawney, Pa.

New York & New England.—The Board of Councilmen, of New Haven, Conn., have voted to accept the offer of W. H. STARBUCK, of $250,000 for the city's interest in the New Haven & Derby road. The purchaser, who represents the New York & New England Co., agrees to extend the line from Derby to Hawleyville within one year, and to maintain a steamer line between New York and New Haven. The transaction will be of great value to both parties, as at present all the entrances to New Haven are controlled by the New York, New Haven & Hartford, and the railroad company on its part, secures valuable docks and terminals at tidewater.

Baltimore & Ohio.—The survey is completed for a branch from Chester to Media, Pa. It is reported that all the surveyors at work on the New York extension have been called in.

New York, New Haven & Hartford.—The directors have decided to remove the company's shops to some point between New Haven and Bridgeport. WM. D. BISHOP, of Bridgeport, is Chairman of the Committee, appointed to select a site.

Cincinnati, Hamilton & Dayton.—Surveys are reported to be finished of the lines from Richmond to Jonesboro, Ind., and from Dayton, O., to Eaton, O., and Liberty Ind.

International.—Work is in progress on the whole line from Megantic to Mattawamkeag, Me. The section in New Brunswick between Harvey and Salisbury, 113 miles, is being located.

Pennsylvania & New England Construction Co.—Plans have been filed for the two-mile approach to the west portal of the Poughkeepsie bridge. At the terminus of the approach will be located the extensive yards and sidings, which the various roads, that are to build connections with this point, will require.

Pennsylvania.—Engineers have been at work near Youngstown, O. The probable statement is that they are locating a short cut off at that point for the use of through trains; but rumor has it that the company is backing the New York, Mahoning & Western project, mentioned below, and will build the line from Youngstown to Van Wert to obtain a line to Chicago shorter and better even than the Baltimore & Ohio proposed outlet over the Pittsburg & Western, noted last week.

New York & Massachusetts.—Surveys are to be made at once for the extension from Boston Corners to Westfield, Mass. At this point it will connect with the Westfield and Holyoke line, and at Holyoke with the new Central Massachusetts, thus giving a route from the Poughkeepsie bridge east, to compete with the Pennsylvania & New England Company's Hartford & Connecticut Western road.

New Projects and Surveys.—*Northern Maine.* This company was chartered last winter, and has effected a preliminary organization. The proposed line is to extend from Presque Isle south to Houlton, and thence *via* New Limerick and Island Falls to a connection with the Maine Central at or near Mattawamkeag, a distance of 70 to 85 miles. A subscription is now being raised in Aroostook county, to amount, with right of way, to $100,000, and when that is secured, which is hoped will be done by early fall, the line will be surveyed. J. B. HALL, of Presque Isle, is interested.

Bath & Parker's Head.—A narrow-gauge line is proposed between these points in Maine. The cost is estimated at $70,000.

Ft. Plain & Richfield Springs and Mohawk & Susquehanna Valleys.—The villages of Ft. Plain and Canajoharie in Central New York are greatly excited over these two rival corporations, whose organization was reported last week. The latter company is headed by New York capitalists. Their selecting Canajoharie as a terminus, instead of Ft. Plain, as was originally intended, has so disappointed the people of the latter place that they have organized the local company as stated.

Columbia & Rensselaer.—This company, which was chartered some time ago, is making surveys and obtaining right of way along its proposed line in Columbia county, New York, 20 miles southeast of Albany. The line is to extend from Niverville on the Boston & Albany, to Stuyvesant, on the New York Central & Hudson River, about ten miles. C. H. STOTT is President, and ALBERT HOYSRADT, of Hudson, is Secretary.

New York, Mahoning & Western.—This company has been incorporated in Ohio to build a line from Youngstown to Van Wert, with headquarters at Findlay. BEN LE FEVRE and others, incorporators.

Carbon, Schuylkill & Western and Clearfield & Alleghany.—These two companies have been chartered in Pennsylvania. The line of the first is to run from Lehigh to Blairsville, Indiana county, with branches to Northumberland, to Phillipsburg, and to East Tyrone. The second line runs from a point in Clearfield county to Alleghany City. The president of both companies is JOHN J. SUMMERS, of Philadelphia, and seven-eighths of the total stock in both corporations is held by GEO A. STIMSON, of New York. The total length of the chartered lines is 500 miles, and the capital stock, $33,-000,000.